MODERN PLASTICS

JULY 1958

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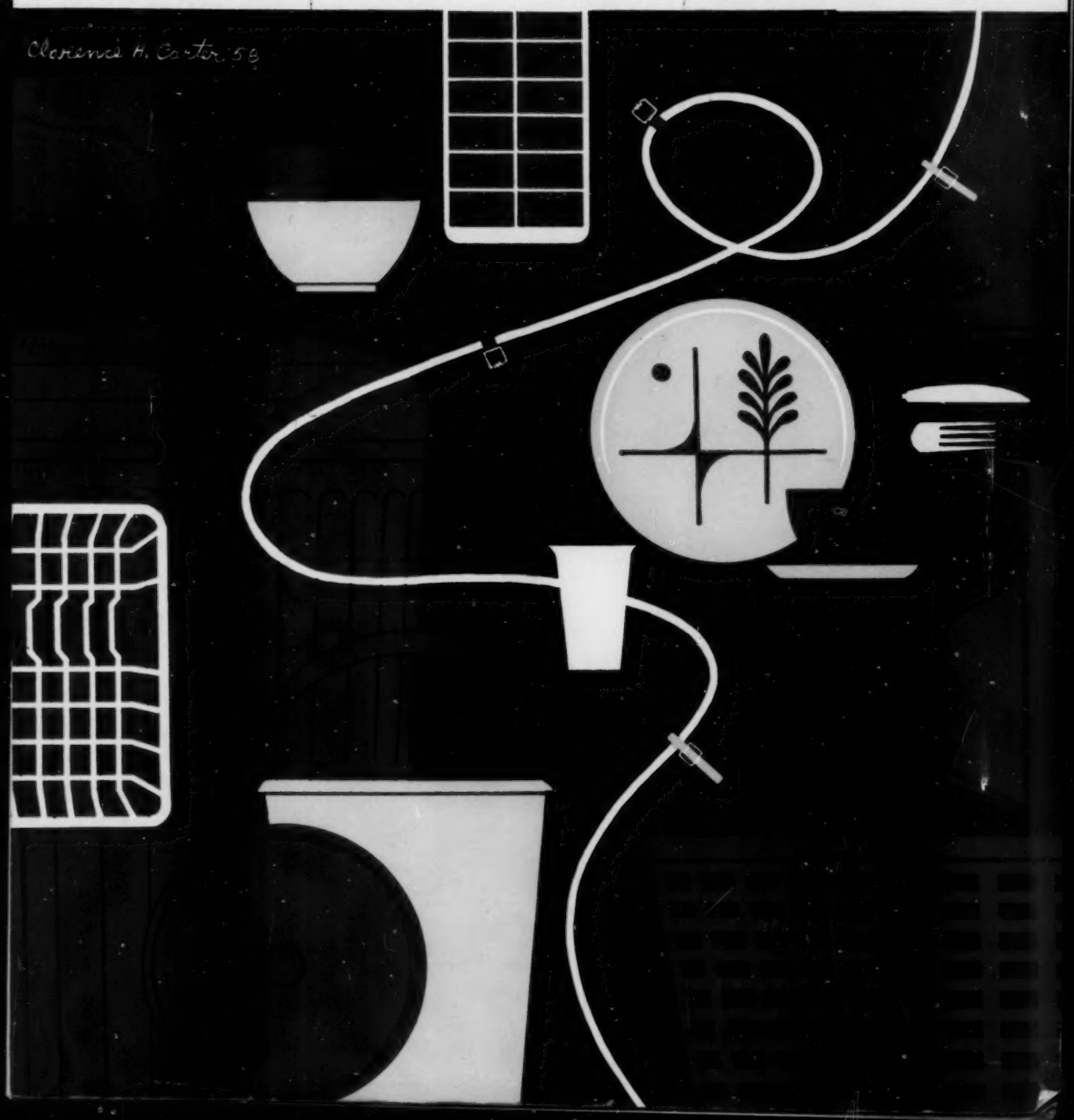

PRODUCT-DESIGN MEMOS FROM DUREZ

Heavy-duty parts
Making epoxies flame-resistant

Metallized phenolics

Chrysler Corporation

Rugged

Got a job that's "too tough for phenolics"?

You might never think of phenolic for a part like this Chrysler-engineered automotive oil-pump gear—subject to wear, heat, friction, constant oil immersion.

But you'd be reckoning without the ruggedness of a new phenolic, *Durez 16771*.

Parts molded from this glass-fiber-filled compound have a flexural strength of 20,000 psi, compressive strength of 16,500 psi. Their tensile strength is 7,000 psi. Modulus of elasticity in tension is 3.0×10^6 psi. What's more, the heat distortion point of these parts is up around 600° F.

Payoff • These properties, plus excellent resistance to oil, water, and acid, made Durez 16771 appear to have some of the properties needed for the Chrysler oil-pump gear. After extensive experimenting and testing, Chrysler engineers developed the plastic gear to replace the usual metal part.

Results: *new gears of Durez 16771 outwear metal gears nearly 3 to 1—show no performance-affecting wear after 200,000 miles; save about two-thirds of the cost of metal gears; run more quietly.*

For a data sheet describing this high-strength phenolic, check opposite "16771" on the coupon.

How to make epoxies resist flame

Your epoxy laminates and castings will shrug off heat, moisture—even fire—if you cure them with a new Durez product called HET® Anhydride.

In the picture that follows, the laminate cured with a conventional hardener ignites in less than 30 seconds and burns to destruction in about 3 minutes. Exposed to a similar flame source for the same time, a HET-cured laminate snuffs itself out as soon as the flame source is removed.

This leads to some interesting possibilities. For instance, you can now make glass-reinforced laminates that keep practically all their flexural strength, *even when heated within the 300-350° F range.*

You can make potting resins that retain room-temperature electrical properties at high humidities *and at temperatures above 300° F*—and won't feed a fire.

For easier casting or wet layup, you need not handle HET Anhydride hot. You can mix it with another anhydride to form a curing system that *stays liquid at room temperature.* Toxicity is very low.

If you'd like complete information on HET Anhydride, methods of use, and properties of cured resins, check the coupon for Bulletins 19 and 43.

Bright idea

Next time you want to put a bright reflective surface on a part, think of *metallized phenolic.* It may save you a costly production step.

American Optical Company

For instance, this housing for a microscope lamp requires a mirror to focus the light.

To sidestep the cost of a custom-made mirror, the housing is molded of Durez phenolic. Then an aluminum mirror is deposited right on the plastic by vacuum evaporation.

This is easy to do with the Durez compound chosen for this part. It provides a good hard surface for metallizing. It incorporates other wanted properties: high impact strength and low thermal conductivity.

You're on sure ground when you base bright ideas like this on phenolics. They give you a bigger choice of controlled properties than any other material in their class. You can select the right balance from *more than 150 Durez compounds.*

To take a fresh look at today's phenolics, just check the coupon for a new four-page bulletin describing some typical Durez molding compounds and what you can do with them.

For more information on Durez materials mentioned above, check here:

- ☐ High-impact Durez 16771
- ☐ HET Anhydride—Bulletins 19 and 43
- ☐ Phenolic molding compounds—descriptive bulletin

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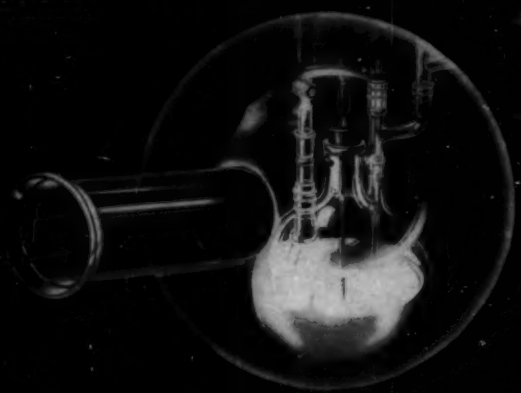

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CHEMICALS

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INDUSTRIAL RESINS

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Catalin

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Another new development using

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Texhote steel, made by Sun Steel Company, Chicago, Ill., is used on Admiral Slimline portable TV sets in pigskin tan and black leather finishes. Texhote finishes on steel or aluminum can be obtained in any color in a wide variety of textures. Plastisol is formulated by Bradley & Vrooman Company, Chicago, Ill. B.F.Goodrich Chemical Company provides the Geon polyvinyl material only.

Admiral TV set proves the case:

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The Geon coatings also offer superior abrasion, electrical and chemical resistance. It's another example of how versatile Geon can provide the key to a new or improved product. For more information, write Dept. LE-7, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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GEON polyvinyl materials • HYCAR American rubber and latex
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1 Nylon replaces metal in this idling cam made by Chicago Molded for Holley Carburetor. By injection molding it of nylon, Chicago Molded eliminated 3 operations—hardening, stamping and assembly. *This cuts production costs 50%.* Chicago Molded went even further and designed a unique mold with removable sections. This represents advance planning for easy changes in the number and sizes of the ratchets at lowest expense. Picture how this kind of foresight could keep your costs down.

2 One part replaces three in this paint spray gun body developed with the help of Chicago Molded. By injection molding it from nylon as a single part, Chicago Molded eliminated several machining, polishing, buffing and plating operations previously required for metal guns. In addition to the cost-cutting advantages of this new nylon design, it is two-thirds lighter, is not affected by solvents, and makes a tighter air seal than die-cast aluminum. Do you have a similar part or component?

4 ways *Chicago Molded might cut your parts costs*

3 This new "Schlitztap" looks like expensive bone china, but it's actually made of melamine. Engineered and molded by CMPC, the plastic parts of the "Schlitztap" not only cost less than their ceramic counterparts but are almost indestructible. They're immune to perspiration, scratching, staining and chipping. This is the first time that it has been practical to duplicate decorated ceramics that have compound curved surfaces.

4 An injection-molded—31" x 16" —styrene cover replaces a die cast part at a lower cost in this Magna Bandsaw. Furthermore, the color's *in* the plastic, eliminating the cost of painting during manufacture. And the cover can't chip, peel, or fade. Chicago Molded's engineers can suggest ways to make good products better *and at lower cost* through the use of molded plastic parts.

LET CHICAGO MOLDED KNOW YOUR COST PROBLEMS It may be possible to solve them and make a better product too—with a slight change in design, or material, suggested by Chicago Molded. Our engineers have exceptional experience in doing just this. Your problems are their job. So let us know if we can be of help. Contact:

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PRODUCTS CORPORATION
1032 North Kolmar Ave., Chicago 51, Ill.

The market makers

If the plastics industries could learn anything from the recent National Packaging Show, it is that the making of markets is a most complicated matter.

Let's take a case in point: polyethylene film.

By the end of 1957 there was production capacity for approximately 920 million lb. of polyethylene, mostly low-density material. And in 1957 about 630 million lb. of polyethylene were sold, 205 million lb. of which went into film.

Early in the fall of 1958 there will be capacity for around 1 billion lb. of low-density polyethylene and almost 400 million lb. of high-density polyethylene. Where is it going to go?

There is an easily foreseeable market of 300 million lb. of film in 1958. Film, and particularly packaging film, is a major factor in both present and future markets. And what was evidenced at the Packaging Show is that cooperation between material makers, processors (extruders), converters, packaging machinery manufacturers, and users is the key to increased application. These are the market makers!

Item: Polyethylene film for bread wrap. The possible market for this product, competing with wax paper, is variously estimated between 100 million and 150 million lb. a year. But if that market were all available today, there would not be enough film grade resin to supply it.

Item: Flat-cast film extrusion. Standing idle are quite a few paper-coating polyethylene extruders. And it has now been shown that these may be converted to dry-cast film extrusion for packaging applications.

Item: Thin-gage polyethylene film. Exhibited at the Show was tubular blown extruded polyethylene film, $^{2}/_{10}$ of a mil in thickness. No use has yet been found for it. But the economics are simple. One mil cellophane works out to 20,000 sq. in./lb.; 1 mil polyethylene to 30,000 sq. in./lb.; $^{2}/_{10}$ mil polyethylene to 150,000 sq. in./lb.

Item: Bags for shipping agricultural chemicals, aggregates, cement, and plastics powders. These compete with multi-wall bags, have re-use advantage to farmers, are profitably disposable to others.

The making of markets is everyone's responsibility, from chemists to users. Any doubt about the future of the polyethylenes must be dispelled by the exhibits at the National Packaging Show.

The market makers in all other plastics materials (and that includes everybody) can learn a lesson from this Show.

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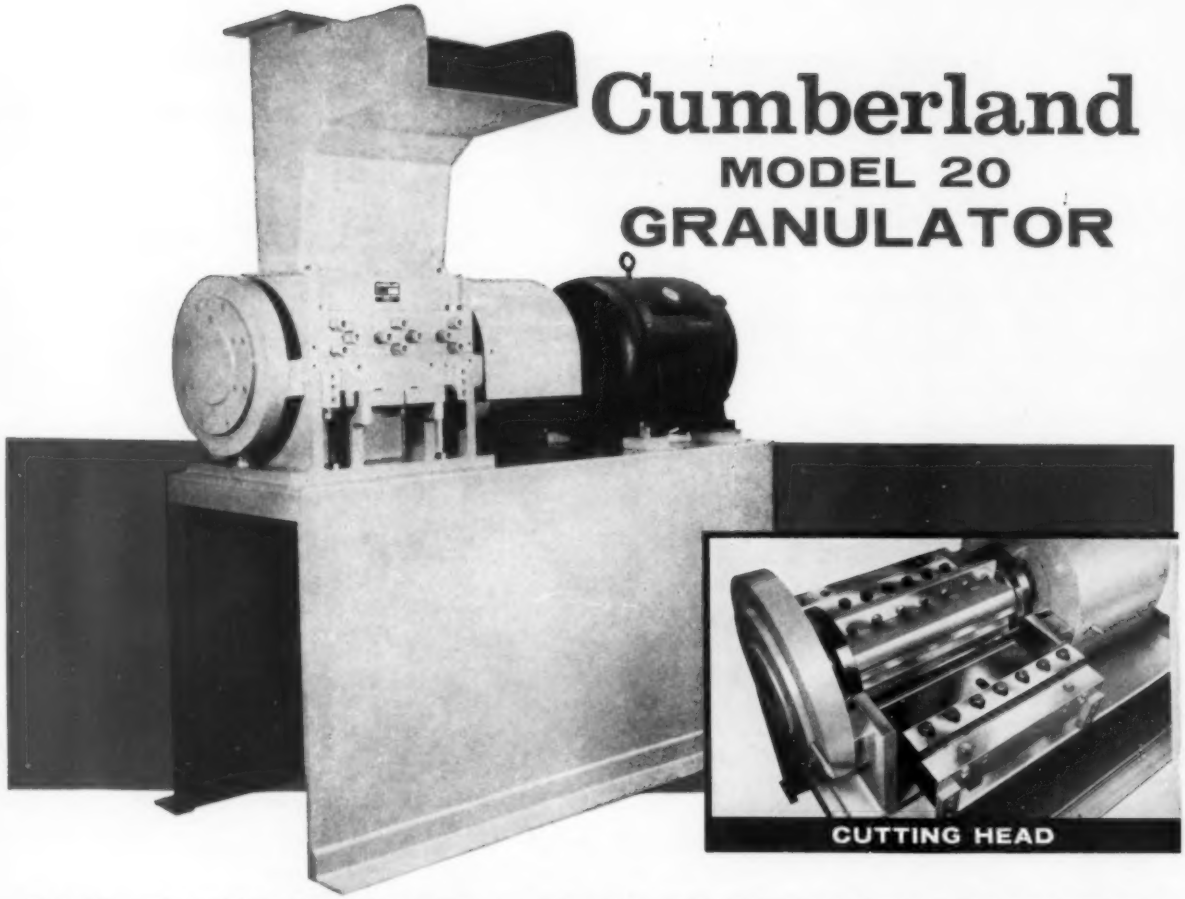

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Watch future ads featuring other outstanding Cumberland machines and write for Bulletin 260

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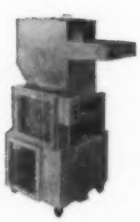

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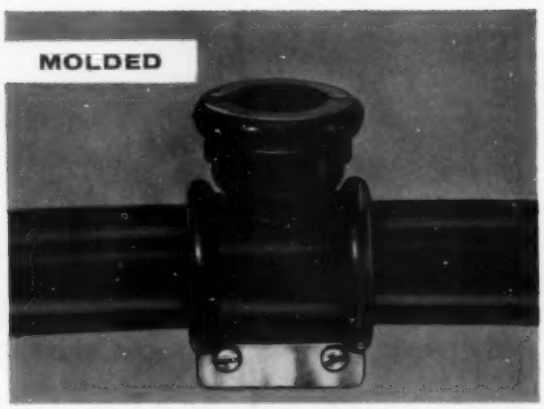

PIPE TEE is easily and economically molded of ALATHON 5 for use with pipe of ALATHON 25 and other non-metal piping systems. Resistant to temperature extremes and stress cracking, the non-corrosive full-flow tee eliminates pipe cutting, assures a non-leaking fit. (Molded by Phalo Plastics Corp., Worcester, Mass.)

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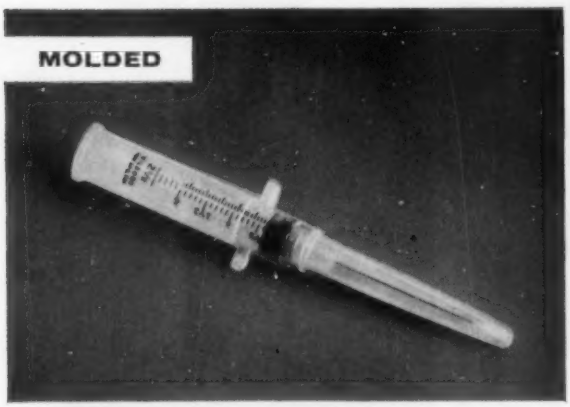

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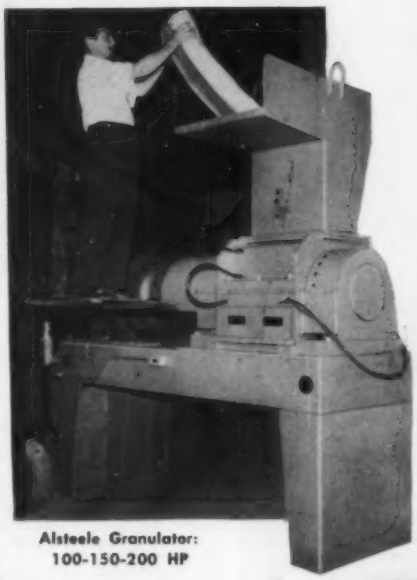

Alsteele Granulator: 100-150-200 HP

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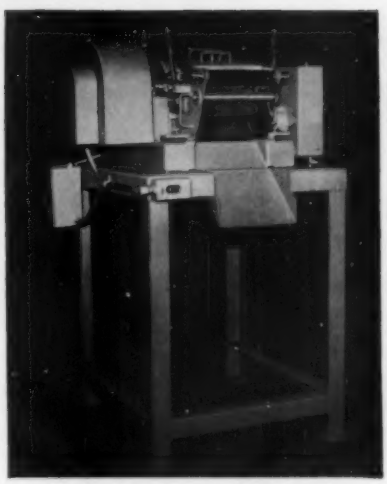
Alsteele Pelletizers

The Alsteele line of pelletizers works with extruders 2½" to 6" or larger. Instant synchronization with an extruder is made possible by the U. S. Varidrive. And ease of operation, maintenance and cleaning is insured by extremely compact design.

Additional features are excellent uniformity of pellets, and clean cutting action—even on elastomerics. A greatly lowered noise level is still another benefit.



Hi-Speed Pelletizers to handle entire extruder output

ALSTEELE ENGINEERING WORKS, INC.

Call or write our office nearest you for full price, performance and specification data.

84A Herbert St. Framingham, Mass. TRinity 5-5246, -5247

REPRESENTATIVES:

New York Area: RICHARD ROSS, EL 5-5633, New York City

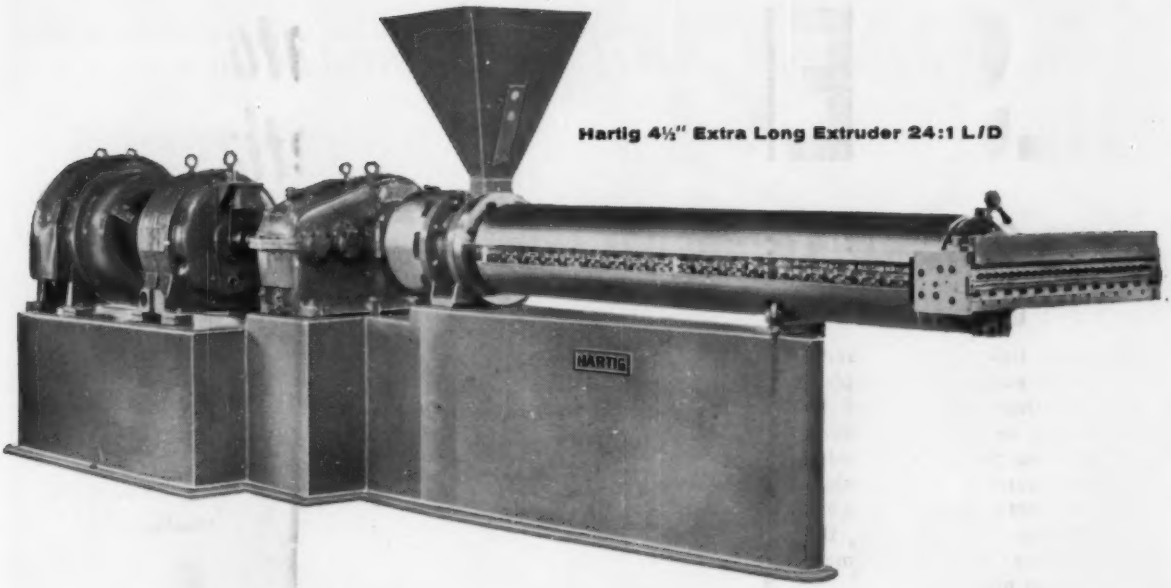
Chicago Area: C. J. BERINGER CO., 727 Echo Lane, Glenview, Ill.

Detroit & Cleveland Area: C. H. WHITLOCK ASSOC., 21655 Coolidge Hwy., Oak Park, Mich.

Pittsburgh Area: AUTOMATION EQUIPMENT & SUPPLY CO., 513 Empire Bldg., Pittsburgh, Pa.

In Canada: B. J. DANSON ASSOC., 1912 Avenue Rd., Toronto, Ont.

West Coast: EDMUND J. LYNCH, 2025 Martha Lane, Santa Ana, Calif.



Hartig 4½" Extra Long Extruder 24:1 L/D

HARTIG EXTRUDERS

Designed for Today's Needs...and Tomorrow's

Heat on Barrel: 19 bands at 3500 watts each
4 Control Zones on barrel and 1 on die head
5 Temperature Controls (proportioning type)
Effective Length of Screw: 108"
Thrust Bearing Capacity: 270,000 pounds
Floor Dimensions: 153" x 70" (belt drive machine)
Approx. Weight: 6000 pounds
Nominal Capacity: 350 to 400 pounds per hour
Motor Drive: 50 to 100 HP
(direct or V belt drive optional)

Extruders from 1¼" through 12" bore / Standard 15:1 L/D / Extra Long 21:1 L/D, 24:1 L/D, 30:1 L/D

Send for your copy of the new booklet describing the complete line of Hartig Extruders.

THE MIDLAND-ROSS GROUP OF COMPLEMENTING SERVICES

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John Waldron Corporation, New Brunswick, N. J.
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Ross Engineering of Canada Limited, Montreal
Ross Midwest Fulton, Dayton
Hartig Extruders, Mountainside, N. J.
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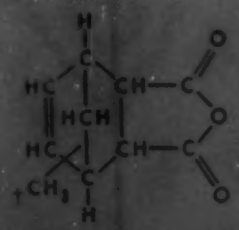
HARTIG EXTRUDERS

ESTABLISHED 1890
A UNIT OF J. O. ROSS ENGINEERING DIVISION
MIDLAND-ROSS CORPORATION
MOUNTAINSIDE, NEW JERSEY

From National Aniline Research

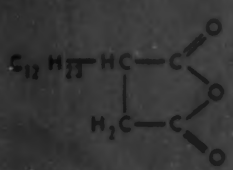
3 Easier-to-Use CURING AGENTS FOR EPOXY RESINS*

METHYL NADIC® ANHYDRIDE

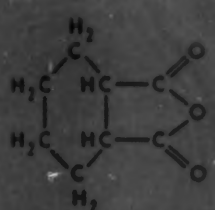


† the methyl group replaces one of the hydrogens

DODECENYL SUCCINIC ANHYDRIDE



HEXAHYDROPHTHALIC ANHYDRIDE



These National Aniline Curing Agents have six important advantages for epoxy resin users:

Ease of Handling – Two are liquids, the third a low melting (35°C) solid. Thus, they can easily be mixed with liquid epoxy resins at or slightly above room temperature. Or solid epoxies, heated slightly above the melting point, can be blended with the anhydrides.

Lighter Colored Clear Castings.

Greater Latitude in Formulations – both for desired heat distortion temperature (HDT) and finished castings hardness.

Longer Pot Life of Catalyzed Resins.

Lower Volatility at curing temperatures and lower peak exotherms.

Excellent Thermal Stability of cured resin.

Technical Data Sheets giving properties on each anhydride are available. Working samples and prices will be furnished on request. The coupon below is for your convenience.

Also available from National Aniline
MALEIC ANHYDRIDE • PHTHALIC ANHYDRIDE

* as described in U.S. Patent #2,324,483

Allied Chemical

NATIONAL ANILINE DIVISION ALLIED CHEMICAL CORPORATION • 40 RECTOR STREET, NEW YORK 6, N. Y.

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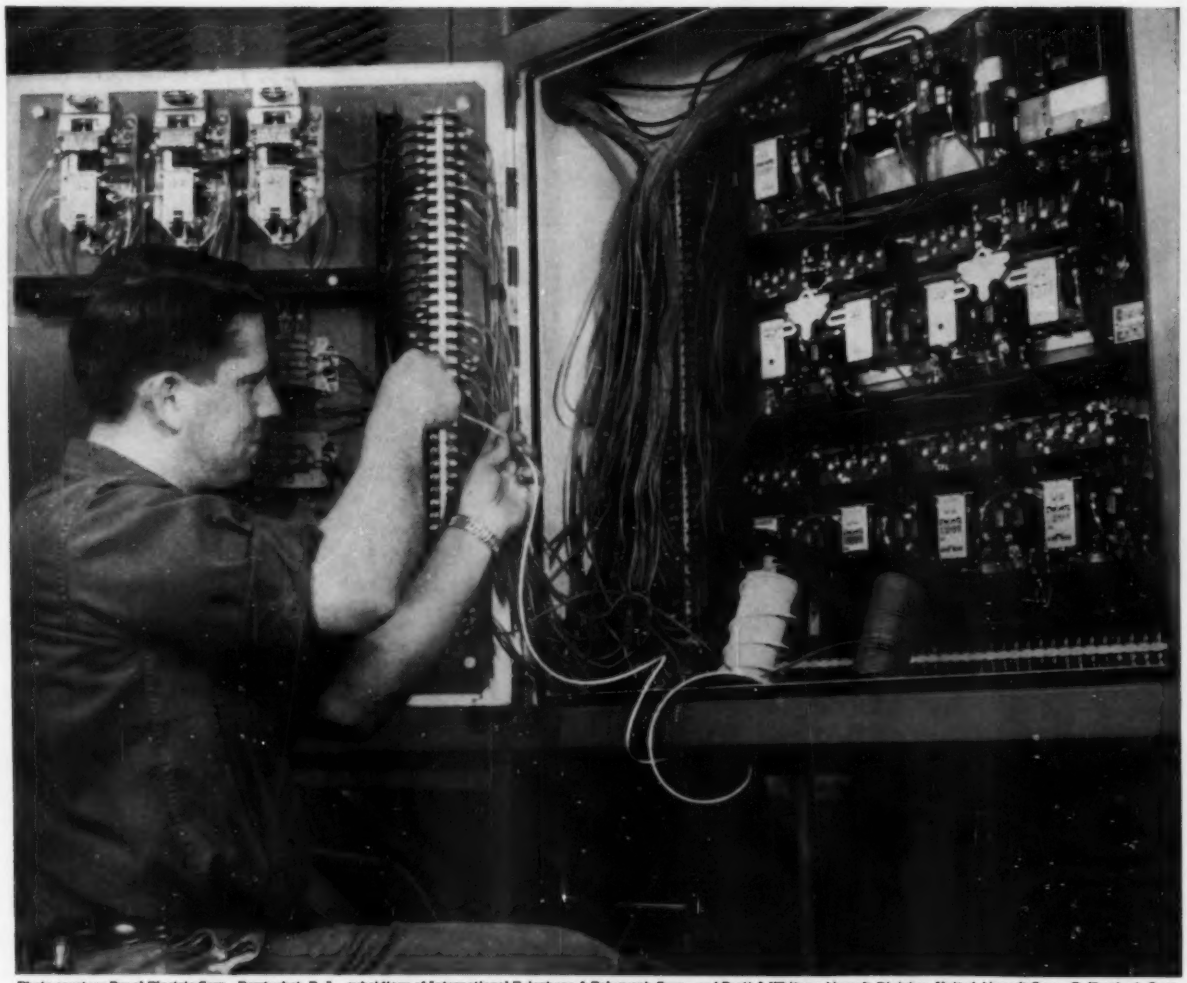

Photo courtesy Royal Electric Corp., Pawtucket, R. I., subsidiary of International Telephone & Telegraph Corp., and Pratt & Whitney Aircraft Division, United Aircraft Corp., E. Hartford, Conn.

How to keep an impulse on the right track

Ever wonder how an electrician keeps the many actuating impulses for an automatic machine tool, or similarly complicated equipment, on the right track? His secret lies in the brightly hued jackets for the many wires involved. By following a simple color code, he swiftly and surely solves any circuit.

Not so simple, however, was finding the right kind of colored covering for machine tool wire. It had to be thin, tough, highly insulative, resistant to oil, fumes and age—plus being available in a wide range of bright, permanent colors. A vinyl compound seemed logical, but not all vinyl resins could meet the tight specifications.

After much testing, a leading wire manufacturer finally chose PLIOVIC EDB90V—a dry-blending, electrical-grade vinyl resin—plus other materials for the job. The reasons: 1. Uniform particle size 2. Minimum dusting 3. Compatibility 4. Smooth extrusion 5. Superior insulation resistance and dielectric strength 6. Excellent physical properties.

If you have a need for a high-quality electrical grade vinyl resin, why not learn more about PLIOVIC EDB90V? Find out also about the other members of the PLIOVIC family. You can just by writing for details plus the latest *Tech Book Bulletins* to: Goodyear, Chemical Division, Dept. R-9422, Akron 16, Ohio.

CHEMICAL
GOODYEAR
DIVISION

PLASTICS
DEPARTMENT

Chemigum, Pliaflex, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS

High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

Acetate Sheeting...

the perfect plastic material for blister packaging. JODA extruded acetate sheets, rolls and film in light to heavy gauges — transparent, translucent or opaque — is excellent for vacuum forming. The packaging shown here, used to display metal gauges, has a sturdy polyethylene body and crystal clear acetate cover. It's made entirely of JODA plastics by Kastar, Inc., New York City, who know that well-packaged products sell better.

BUTYRATE and LINEAR POLYETHYLENE available in standard sizes.

For information and samples, contact

JOSEPH DAVIS PLASTICS CO.

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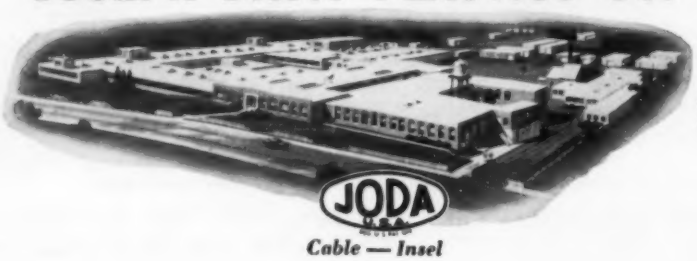

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GERING

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- **VIRGIN MOLDING COMPOUNDS**—Vinyl, Polyethylene, Acetate, Polystyrene, Impact Styrene
  —**"COLOR COMPOUNDING SPECIALISTS"**—Your orders formulated to exact color, flow and physical properties specifications.
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- **RIGID QUALITY CONTROL • COMPETITIVELY PRICED • SPEEDY DELIVERY**—no matter how large your order! Write Us About Your Specific Needs Today!

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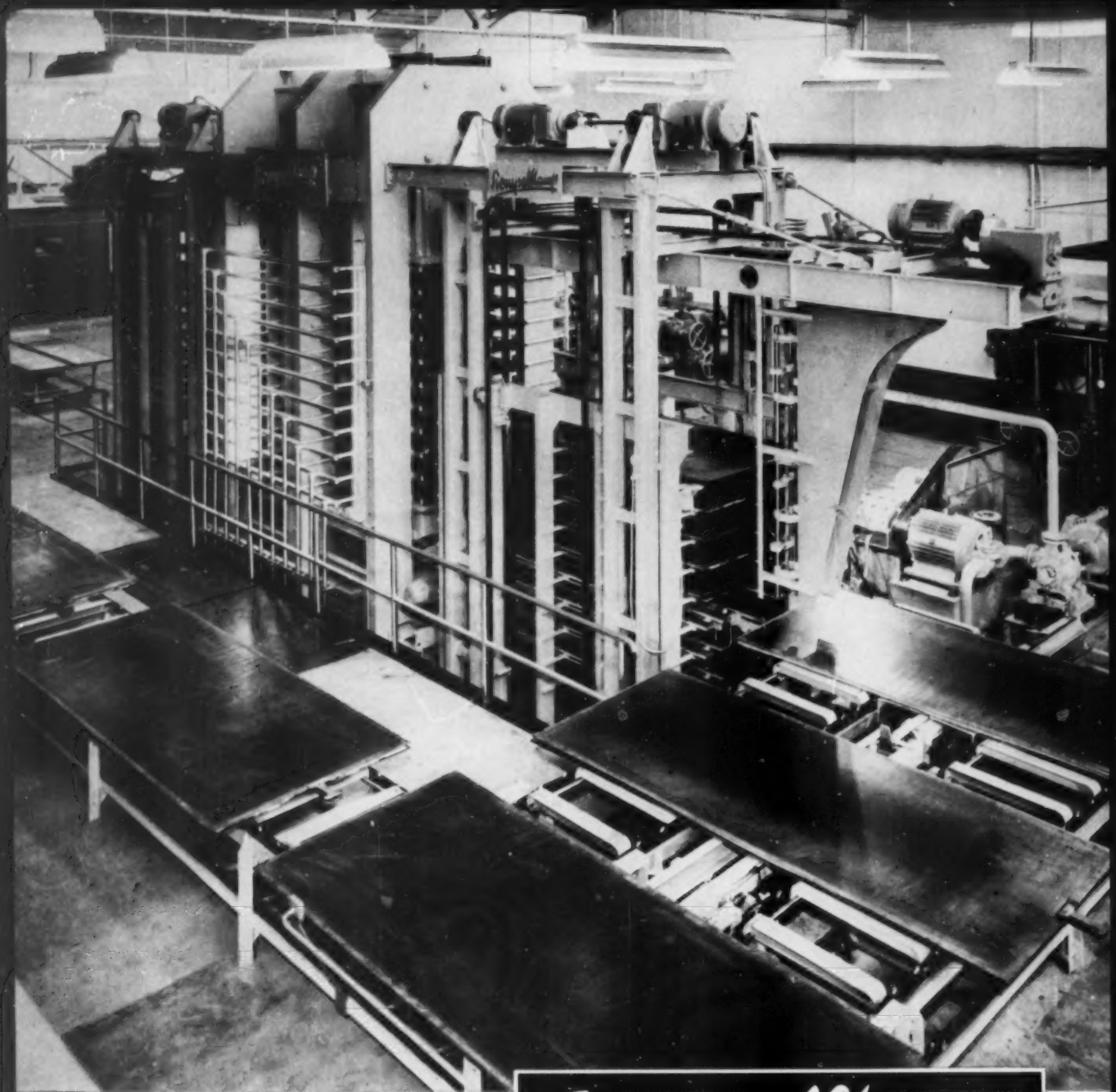

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Special hydraulic presses

for the plastics industry
for any pressure and temperature
with automatic loader and unloader

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Florida's damp salt air doesn't harm these attractive lamps. They never need painting. MARLEX *won't rust!*

Home in the new Coral Key Villas section near Pompano Beach, where more than 120 Cape Codder lanterns are installed, and 690 are planned.

CAPE CODDER LANTERN MADE BY ENGINEERED PRODUCTS, INC., KIRKWOOD, MO.

A revolutionary, new lantern that can't crack, peel, or rust even in salt air because it's made of MARLEX*

RIGID POLYETHYLENE

"Damp salt air and intense sunshine are tough on most materials. We think MARLEX is just the ticket for these difficult conditions," says George O. Palmer, Owner, Palm-Aire Construction Company, Pompano Beach, Florida. "MARLEX is a durable plastic that can take plenty of punishment. Lanterns made of it stand up well in all kinds of weather."

Every day MARLEX is finding its way into new uses. In many cases this premium quality rigid polyethylene is the least expensive material that can meet manufacturers' strict specifications.

MARLEX is highly versatile, too. It can be molded into attractive colorful housewares or used in many heavy duty industrial applications. It can be extruded into tough film or filaments. It's odorless, tasteless . . . can be steam-sterilized . . . is unaffected by most acids, alkalies, and oils.

For full information, call your nearest MARLEX sales representative.

*MARLEX is a trademark for Phillips family of olefin polymers.

PHILLIPS CHEMICAL COMPANY, Bartlesville, Oklahoma

A subsidiary of Phillips Petroleum Company

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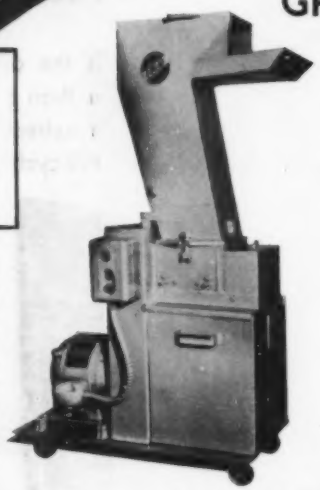
INJECTION MOLDERS!

BOOST PRODUCTION!

M-3 IMS M-4 GRANULATORS

All machines illustrated here in stock for

IMMEDIATE DELIVERY



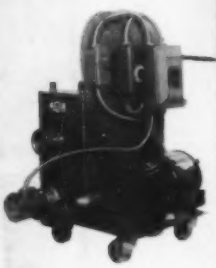
The IMS M-3 6½" x 7" throat sprue grinder — rugged — simple in design—easiest to clean — built-in throat clearance bar — casters — catch pan.

PRICE: Complete with 1 HP Motor and Starter ---$598.50
Same, but with 2 HP Motor --------$645.00

The IMS M-4 5⅜" x 8½" throat grinder — designed primarily for vinyl, polyethylene, plastisols and all elastomerics where a fine-free low bulk factor product is desired — large throat for large injection molded parts.

PRICE: Complete with 2 HP Motor and Starter $788.50
Same, but with 3 HP Motor $854.00

CONSTANT MOLD TEMPERATURE REGULATOR



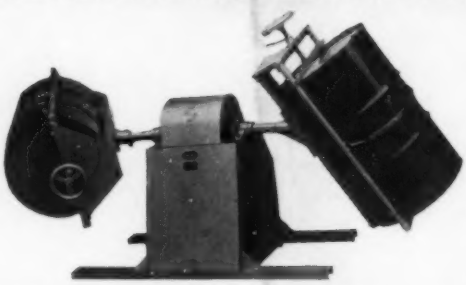
The IMS Economy Circulator — **priced at only $369.50 complete (oil model for heats to 450° at $482.50)** — duplicates performance of mold heaters costing up to 6 times as much — developed by a molder for molders — compact — portable only 15½" x 22" floor space.

Send for our New Nozzle Catalog and Heater Band Book Today. You'll find all styles of nozzles and heater bands fully described and priced, with technical notes on nylon molding.

Prompt service on all kinds of nozzles by the world's largest and most experienced nozzle and heating cylinder specialists.

IMS DRUM TUMBLERS

FOR ALL COLORING AND MIXING OPERATIONS



All IMS Drum Tumblers are based on design suggestions of the leading material and colorant suppliers.

Available for immediate shipment from stock.

¾ HP Model ---------- $595.00
(Takes drums up to 33" high x 22" in diam.)
2 HP Model ---------- $897.50
(Takes drums up to 37" high x 23¼" in diam.)
3 HP Model ---------- $1285.00
(Takes drums up to 45" high x 24" in diam.)

INJECTION MOLDERS SUPPLY CO.

3514 LEE ROAD, WYoming 1-1424
CLEVELAND 20, OHIO

HPM

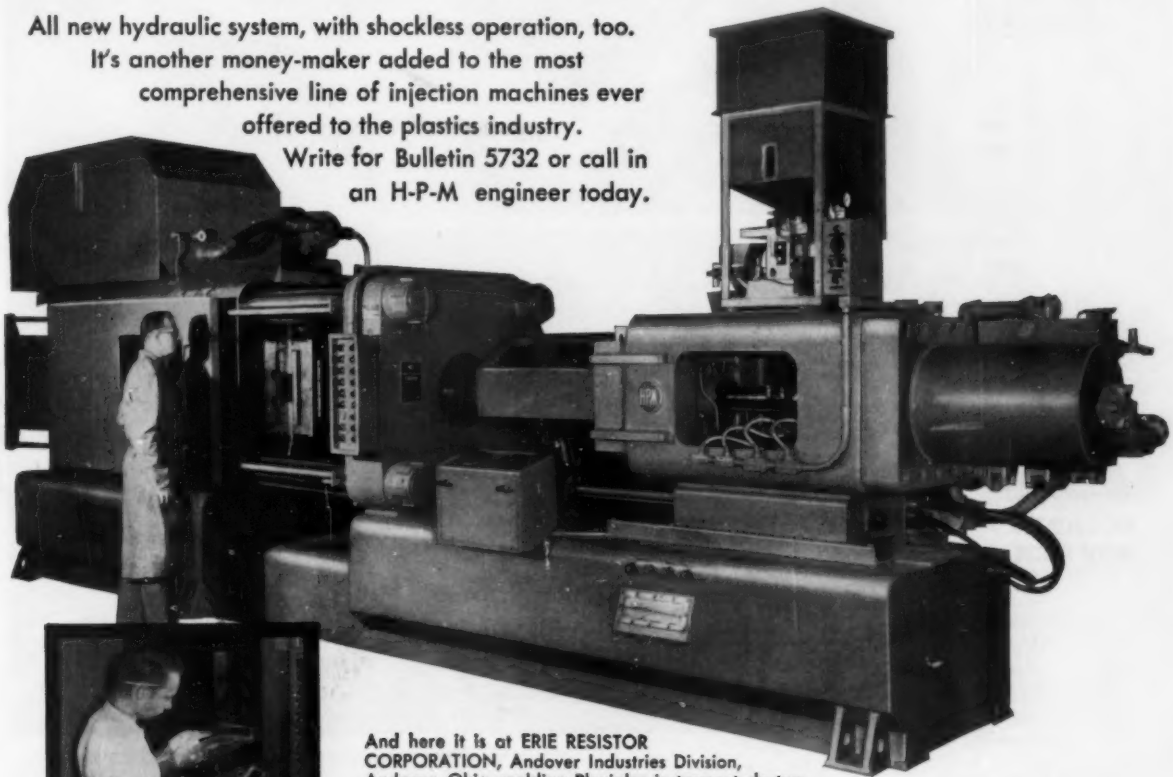
HERE IT IS — THE BIG NEW 32/42 OZ.

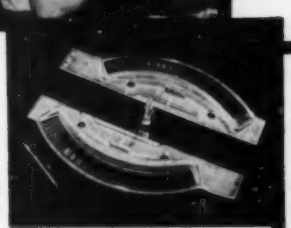
NEW

IN CONCEPT
IN HIGH INJECTION SPEED
IN FAST CYCLING

The H-P-M Model 650-HV-32/42 injection machine is the only really modern, high-speed machine in its size range. The "32/42" is faster than comparable machines on the market today. Reasons: a total of 107½ H.P.; an extremely high injection speed of 2510 cu. in./min.; exceptionally fast cycling of over 300 cycles per hour.

All new hydraulic system, with shockless operation, too. It's another money-maker added to the most comprehensive line of injection machines ever offered to the plastics industry. Write for Bulletin 5732 or call in an H-P-M engineer today.





And here it is at ERIE RESISTOR CORPORATION, Andover Industries Division, Andover, Ohio, molding Plexiglas instrument clusters for a 1958 automobile—in a two cavity mold.

SPECIFICATIONS

Clamp Tonnage	650
Platen Size	48"x48"
Mold Space (Max.)	30"x48"
Stroke	30"
Daylight	50"
Daylight (Without Ejector Box)	58"
Injection Speed (cu./in. per min.)	2510
Plasticizing Capacity (lbs. per hr.)	300
Horsepower	107½
Dry Cycles (per hour)	300

H-809

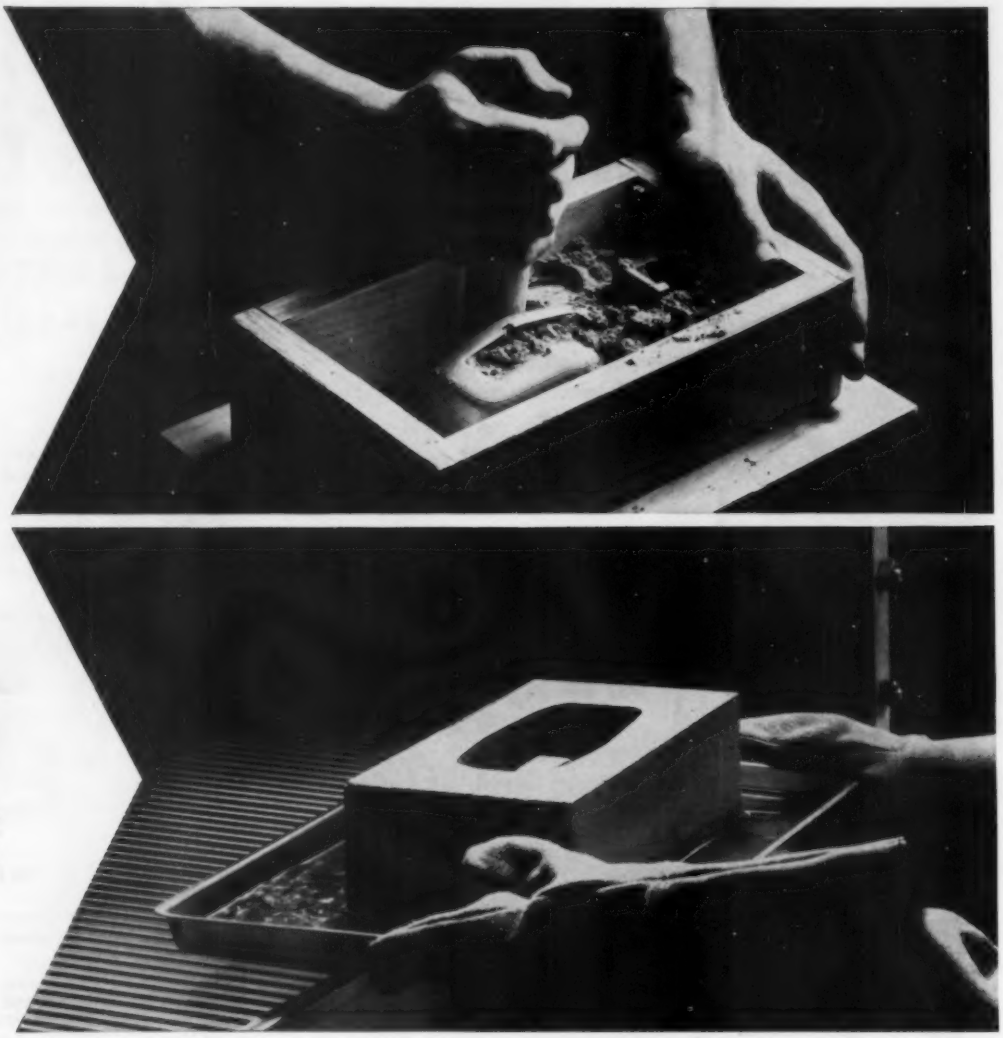
HPM

THE HYDRAULIC PRESS MFG. COMPANY

A DIVISION OF KOEHRING COMPANY • MOUNT GILEAD, OHIO, U. S. A.

3M Chemicals opening new worlds of use for plastics

New compound cuts tool making to two simple steps



Now a tooling compound that eliminates waste, weighing, mixing, pot-life and toxicity problems. It's new 3M Brand Tooling Compound 112.

Here's all you do to make tools with Tooling Compound 112:

- mold and dry a preform of aluminum-based powder.
- place the preform in resin which impregnates the preform as it oven cures.

The result—dense, durable dies that can open entirely new fields to you. They have high strength, thermal conductivity and heat stability. In injection, compression or vacuum molding, Tooling Compound 112 lengthens die life, shortens molding cycles. Dies have no size limit, are easily machineable.

Compared to conventional compounds, Tooling Compound 112 simplifies your die making, avoids material waste. You can return excess molding powder and resin to their separate cans. Compared to metal dies, Tooling Compound 112 can reduce die costs as much as 50% to 90%. Average cost savings are over 70%.

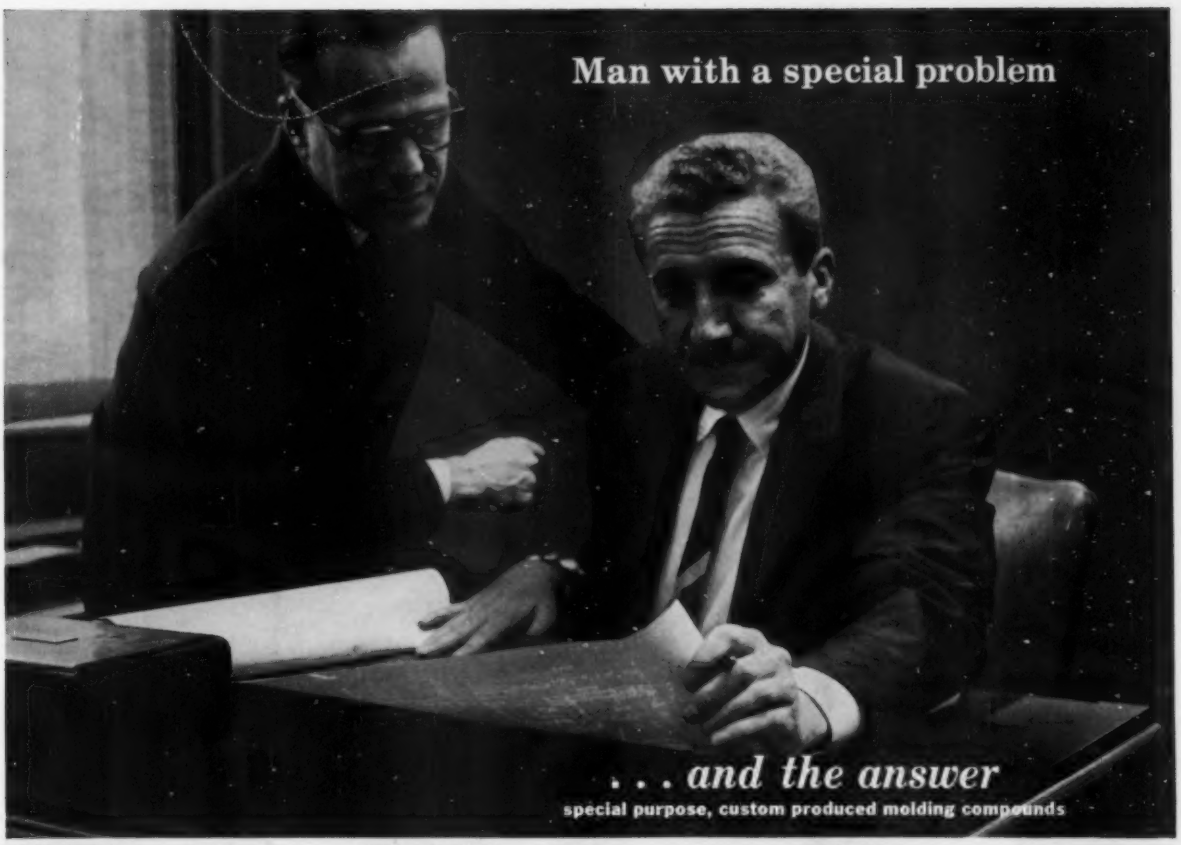
Cut your tooling costs and time! Investigate new 3M Brand Tooling Compound 112, get free literature. Write: Chemical Products Group, 3M, Dept. WQ-48, St. Paul 6, Minnesota.

Hastings Chemical Division • Chemical Products Group

MINNESOTA MINING AND MANUFACTURING COMPANY

. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY CHEMICALS



PLENCO

Here's further evidence of the way Plenco engineers have responded to the needs of manufacturers and designers. *Special* needs, in these instances, demanding special answers . . .

For, although the basic properties of thermosetting phenolic molding compounds were required, the standard categories available were not ideally suited. Consultation with Plenco was a natural first step. The custom-design and production of *special-purpose* compounds by Plenco was the result. Here are just a few:

- A high thermo-conductive molding compound wherein a specific thermo-conductive coefficient was needed to satisfy design requirements for the proper function of an electrical control device.
- A high impact strength compound possessing high heat resistance plus a specific coefficient of friction.
- A special compound capable of reproducing extremely fine definition with low molding pressures for the production of printing matrixes.
- Service as a special backing for diamond abrasive cutting wheels was the chief requirement of another problem-solving new compound.
- For the production of electrical components extremely sensitive to chlorides, a compound meeting (by means of water extraction tests) a maximum chloride content of not more than 3/10 parts per million.

These compounds are, of course, not stock items. They have been developed to serve specialized industries and to perform under particular conditions. They demonstrate once again that *if phenolics can do it, Plenco can provide it* . . . already made or specially made. We invite you to discuss your product or production problem with us.

PLASTICS ENGINEERING COMPANY

Sheboygan, Wisconsin

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.

Convention of the Grand Order of Boonton Customers

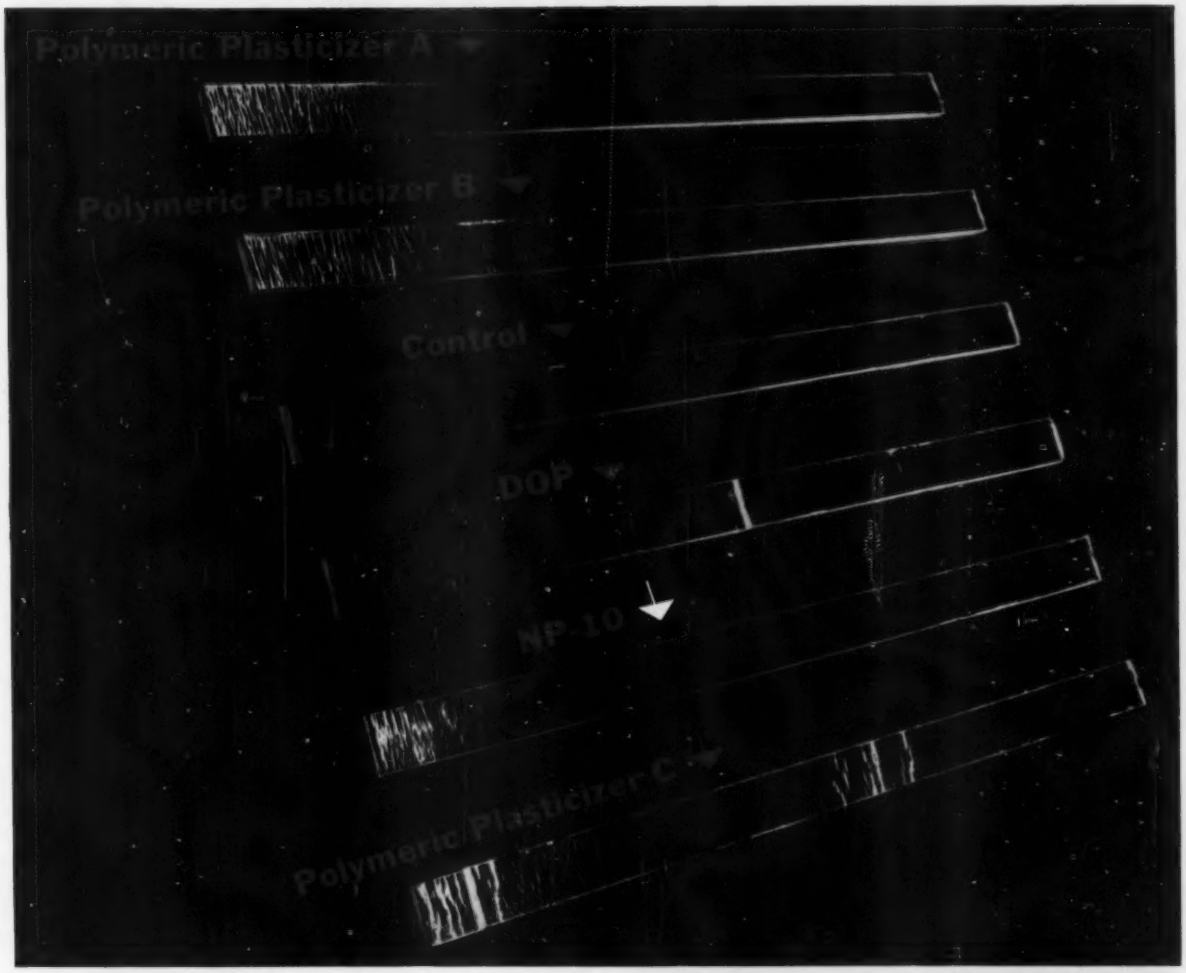
The fellow on the right is from one of the biggest companies in the country, while the chap next to him runs a successful "one-man" plant. The one with the high hat is a real plastics expert (and he'll use no one but Boonton for his important molding assignments). Rubbing shoulders with him is a fellow who doesn't know a darn thing about plastics, but he trusts us with his jobs, too, because he's sure we know our stuff.

These folks come from all kinds of industries—housewares, automotive, appliance, electrical. Some of their products are made entirely of plastics and others just require individual plastics components. In order to do the right kind of job for them we've got an entire plant for compression molding, another for injection molding and a Special Products Division for casting . . . potting . . . low pressure molding . . . dipping . . . and electronic assembly.

At first glance these customers might seem pretty different from one another. But they all have something very definite in common. They're looking for a quality custom service at a fair price. And that's what they get at Boonton. You will too!

BOONTON MOLDING CO.
BOONTON, NEW JERSEY

New York Metropolitan Area—Cortlandt 7-0003
Western New York Area—Alden 7134
Connecticut Area—Woodbine 1-2109 (Tuckahoe, N. Y.)
Philadelphia Area—Pioneer 3-0315



Stress test of **vinyl plasticizers** shows

less polystyrene crazing with Eastman Polymeric Plasticizer NP-10

Crazing and staining of polystyrene surfaces in contact with compounded polyvinyl chloride can be virtually eliminated by using Eastman Polymeric Plasticizer NP-10.

In the test illustrated above carefully molded and cured polystyrene strips were subjected to external stress on an elliptical clamp. To magnify the effect on polystyrene resulting from its contact with plasticized vinyl compound, various plasticizers were poured directly on the strips and allowed to remain for 24 hours, or until fracture occurred.

The photograph shows the results and pointedly illustrates the relative inertness of Eastman Polymeric Plasticizer NP-10 on polystyrene surfaces.

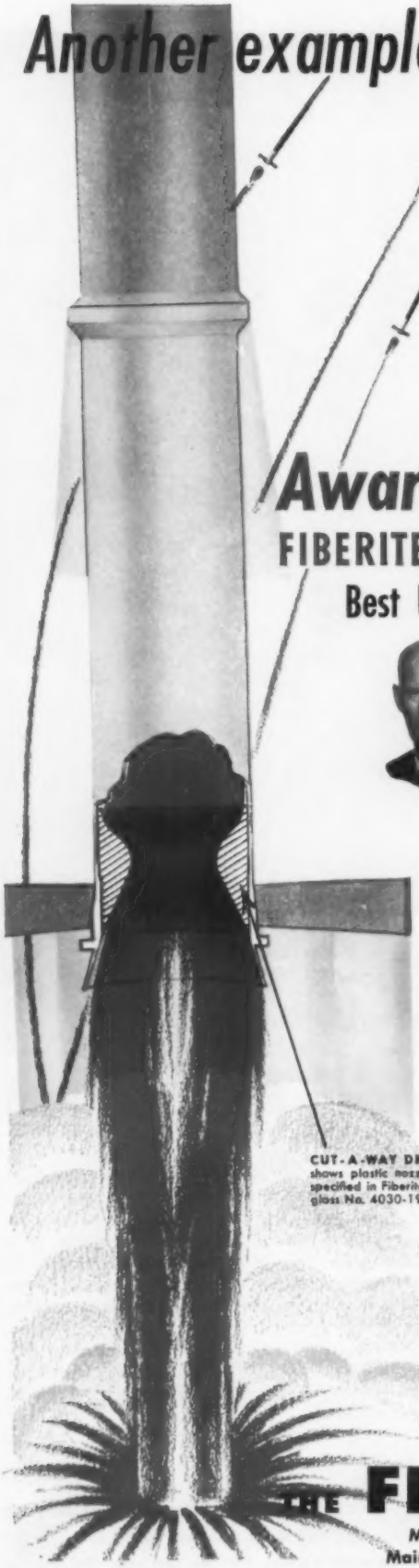
Polymeric Plasticizer NP-10 exhibits permanence characteristics equal or superior to those of high-molecular-weight plasticizers, yet, being itself a compound of moderate molecular weight, blends in easily and rapidly. It is highly resistant to hydrolysis. Its loss from vinyl films to hydrocarbons, soapy water and activated charcoal is extremely low. It is odorless, tasteless, colorless, non-toxic and provides good low-temperature flexibility.

Eastman Polymeric Plasticizer NP-10 is an ideal primary plasticizer for vinyl applications such as refrigerator door gaskets, automotive trim...or wherever maximum permanence is essential.

Eastman CHEMICAL PRODUCTS, INC., KINGSPORT, TENNESSEE, subsidiary of Eastman Kodak Company

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Massachusetts; Cincinnati; Cleveland; Chicago; Houston; St. Louis. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

Another example of FIBERITE at work...



CUT-A-WAY DRAWING shows plastic nozzle section specified in Fiberite phenolic glass No. 4030-190.

Award Winner!

FIBERITE Phenolic Glass Helps Win an Award for Best Use of Materials in Product Design

Paul T. Barnes, Mechanical Engineer, is winner of an M/DE award for his redesign of the "Lar" rocket exhaust nozzle. The nozzle section is molded of Fiberite No. 4030-190. Mr. Barnes says: "In arriving at the use of the Fiberite material many things were tested over nearly a year's time. Fiberite satisfied our requirements. In addition to satisfying application requirements Fiberite also lowered the cost."

The nozzle is molded right in the rocket's combustion chamber at low pressure. Results include: minimum erosion at extreme temperatures (on the order of 5000° F.) . . . leak-proof bond to asbestos liner under high pressure (on the order of 1500 p.s.i.) . . . elimination of trouble-making ring seal needed with other materials . . . simplified machining operations . . . structural replacement of some metal for reduced weight . . . elimination of off-center thrust formerly caused by uneven erosion . . . reliability . . . improved performance . . . costs cut 30%.

Let Fiberite's versatile reinforced phenolic or melamine help you. Write, wire or phone for complete data on Fiberite formulations.

PRODUCT DESIGNER: Paul T. Barnes working with Weapons Development Dept. of the U.S. Naval Ordnance Test Station, China Lake, Calif.

MOLDER: Lee Deane Products, Norwalk, Calif.

MANUFACTURER: Los Angeles Automotive Works, Los Angeles, Calif.

MOLDING COMPOUND: Fiberite No. 4030-190, chopped glass fiber impregnated with phenolic base resin, designed to meet government specifications MIL-M-19536.

EASTERN OFFICE:
Edwin Keusch, 33 Oakland Ave., Bloomfield, N.J., Pl. 8-1233.

CHICAGO OFFICE:
Railway Exchange Building, Michigan Ave. at Jackson Blvd., HA. 7-1164.

WESTERN OFFICE:
Riverdale Plastics, 8510 Warner Drive, Culver City, Calif., TE. 0-7733.

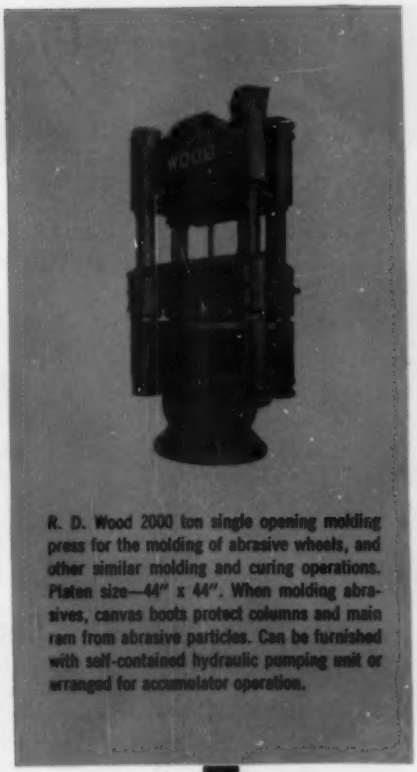
CANADA:
The Bakelite Co., 40 St. Clair Ave. E., Toronto 7, Ontario.

THE FIBERITE CORPORATION

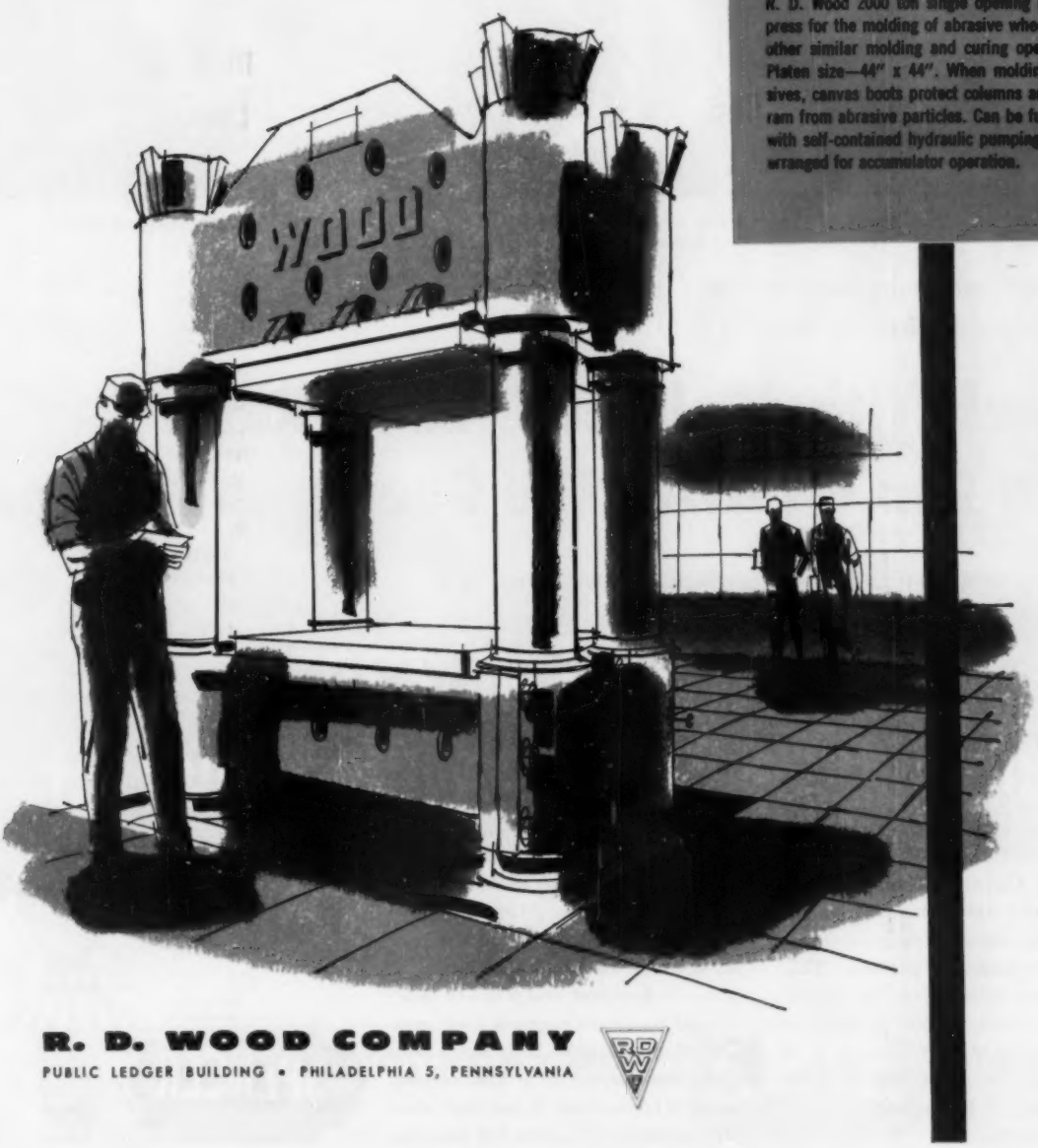
Manufacturers of Plastic Molding Compounds
Main Office: WINONA, MINNESOTA Phone 2316

How to save money on your next press: apply your specs to a basic R. D. Wood design

The result will be exactly *what you want*—just as surely as if you had it designed from scratch. And its cost will be much lower. Working with numerous basic models, R. D. Wood engineers can save considerable design time and expense, and still incorporate *your* specifications in the finished machine. You're sure of its quality, too. For every Wood Press is built by experts using selected materials. This brings additional saving from smooth, dependable performance; fast, economical production; trouble-free operation. *Before* you begin planning your next hydraulic press, consult Wood.



R. D. Wood 2000 ton single opening molding press for the molding of abrasive wheels, and other similar molding and curing operations. Platen size—44" x 44". When molding abrasives, canvas boots protect columns and main ram from abrasive particles. Can be furnished with self-contained hydraulic pumping unit or arranged for accumulator operation.



R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA

Now all these products—and many others being packaged in cellophane—can be over-wrapped with polyethylene film made from Spencer "Poly-Eth Hi-D" 2504 resin.

An important announcement for polyethylene film extruders . . .

Now! With "Poly-Eth" 2504 Resin You Can Go After The Overwrap Market:

With this Spencer medium-density resin, you can make film that is stiff enough for high-speed overwrapping — yet costs less than cellophane.

Think of the huge market available to you if you could supply a low-cost polyethylene film stiff enough to be used in automatic, high-speed overwrapping machines! Now — because of Spencer Chemical Company's development of a special medium-density polyethylene overwrap resin—you can go after this profitable business. This Spencer resin, called "Poly-Eth Hi-D" 2504, has a density of .935 which gives it a high degree of stiffness.

In addition, because it is a medium-density resin, it has extremely high gloss and clarity.

Since 1 mil film made from this resin is about 25% cheaper than cellophane, it should be widely accepted by converters and packagers. And, because it is a medium-density resin, "Poly-Eth" 2504 has many special advantages over other polyethylenes. Most important, because of its stiffness, it can be run on standard packaging equipment. It is easy to heat seal, and it can be easily printed to produce sparkling, eye-appealing packages. It is about four times more grease-proof than conventional polyethylenes. It has high abrasion resistance. It resists low temperature embrittlement, and it withstands heat up to 240° F.

Don't miss out on this chance to cash in on the growing demand for polyethylene overwrap. Get full details on this Spencer "Poly-Eth Hi-D" overwrap resin right now. Contact Market Development Department, Spencer Chemical Company, Dwight Building, Kansas City 5, Missouri.

Poly-Eth *by* **SPENCER**®

These two 150-ton fiberglass molding presses offer 48" stroke... 54-ton pull back. When desired, the opening can be reduced by ram spacers which, in this case, are 12" and 24". The Oil Gear drive offers molders a very accurate pressing speed adjustment ... the ultimate possible. Controls are semi-automatic; plates are 56" x 42". Your maintenance men will welcome the minimum piping and valving on these self-contained presses.

This very rugged fiberglass press is rated 750 tons with a 48" stroke. The two pull backs give 150-ton stripping capacity. Oil Gear drive with quick-acting prefill system allows molders to utilize five ram speeds in their molding cycle. Automatic short stroking of pump at required pressures for long periods of time assures both reduced h.p. consumption and oil heating. Controls are semi-automatic, and the 2 steam-heated platens are 60" x 46".

THERE'S AN ERIE PRESS for EVERY FIBERGLASS MOLDING JOB

Whatever your molding needs, plastic, fiberglass or rubber, why not consult Erie Foundry before you plan? We can be of great help.

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TO FIT YOUR REQUIREMENTS

For you–An electrical grade PVC resin Series to enable you to:

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- Excellent color and clarity
- Uniform particle size
- Freedom from fines
- Outstanding heat stability

- Meet your most difficult specifications.
- Operate at your most efficient speeds and temperatures.
- Produce outstanding electrical products.

These four resins simplify your operation by giving you a wide variety of molecular weights from one manufacturer. You are now able to choose the molecular weight best suited to your own operating conditions.
Help yourself to the benefits you can get from one of these four new electrical grade resins.
Write today for free samples and specifications.

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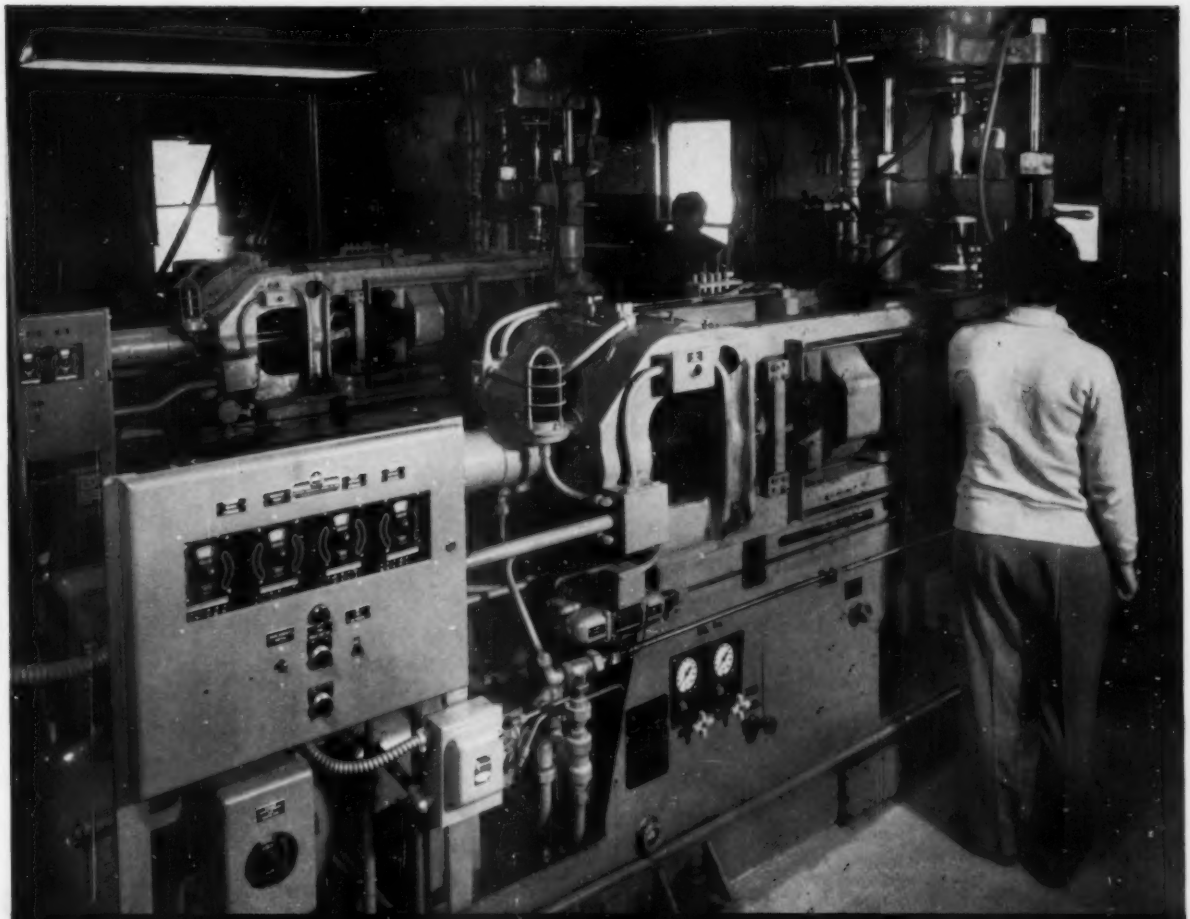


5 oz. of VINYL from a 4 oz. LESTER

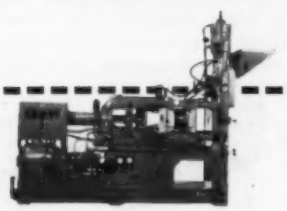
Despite the fact that vinyl is a "derating," heat-sensitive material, they're doing an exceptional job of molding it on a 4 oz. Lester at Draudt Engineering Company (soon to be incorporated under a new name) in Cleveland. The parts shown here are vacuum cleaner hose connectors, a Dreco proprietary item. The 4-cavity shot, including the sprue and runners, weighs a hair over 5 ounces.

Don Draudt, Gen. Mgr., says, "We could hardly believe our eyes when we tested this mold on the 4 oz. Lester – good parts right from the start!

Two important features of the Lester give it the margin of ability to do this job:

1. The unique Lester INTERNALLY HEATED vertical injection cylinder provides for ample plasticizing capacity.
2. The superbly rigid, one-piece cast alloy frame provides an unvaryingly dependable clamp — even for oversize shots. And remember the clamping tonnage rating of every Lester is certified by an independent consulting engineer.

If you're looking for dependable, trouble-free molding, check the performance of Lester machines — in 4, 8, 12, 20 and 60 ounce capacities.



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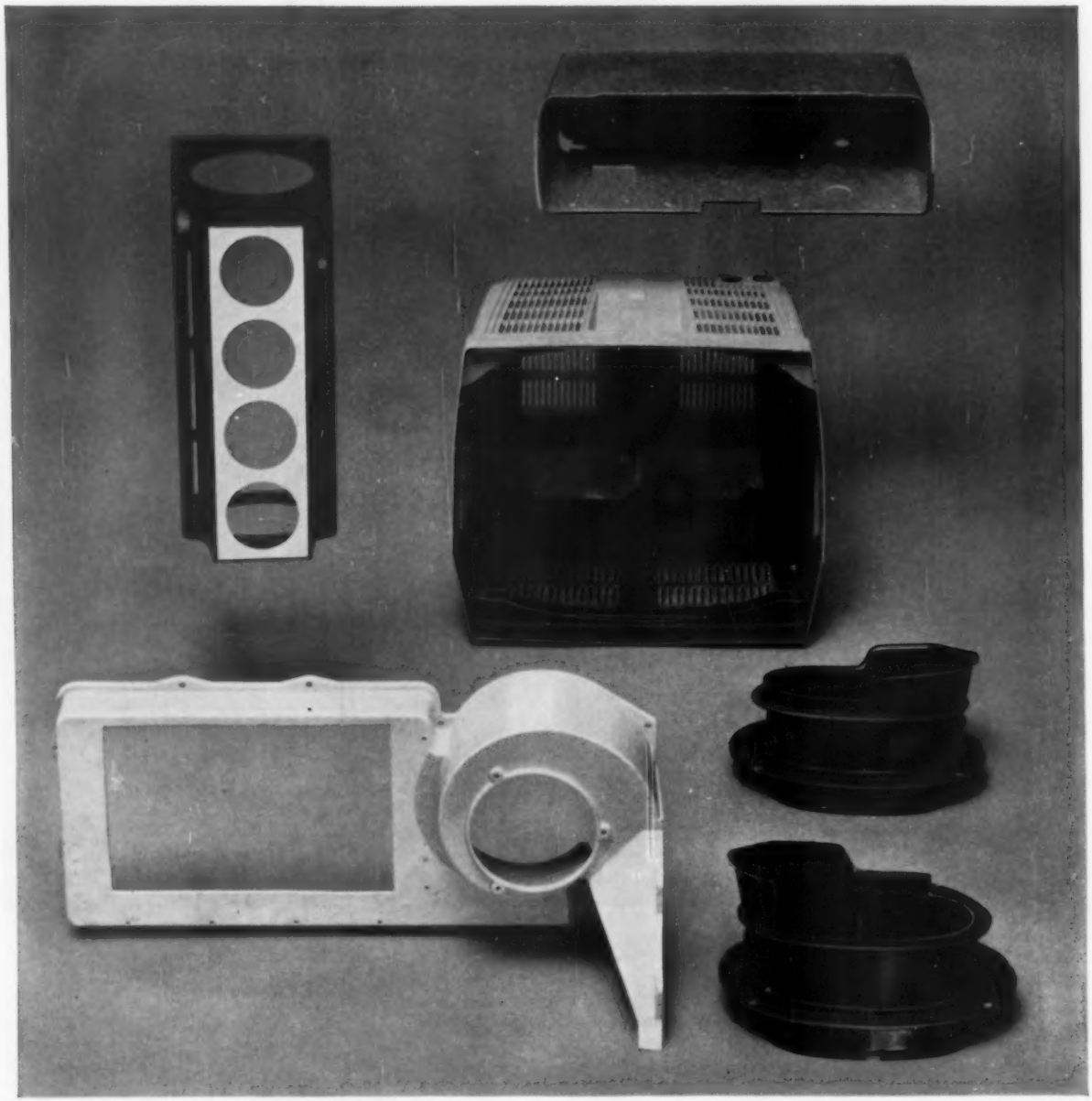


Wide range of premix moldings by the Plastics Division of General American Transportation Corporation includes: automotive air conditioning cabinet for O. A. Sutton Corp., Inc.; Silvertone portable TV cabinet for Sears, Roebuck and Co.; air duct and glove compartment for a leading automobile manufacturer; vending machine air duct for Vendo Co.

Premix moldings give you all three... quality, economy, versatility

Like to market better products and cut costs at the same time? Then premix moldings are for you!

When resins and reinforcing fibers are blended beforehand, more complex molds are not only possible but completely practical. Slots, grooves, holes, bosses and parts with varying wall thicknesses can be formed right in the mold. And whether the part is simple or complex, you'll get moldings with uniform strength and wall thicknesses. Premix moldings are improving products and cutting costs for a wide variety of industries using strong, rigid, reinforced plastics.

Molders across the nation rely on Dow Vinyltoluene and Dow Styrene for top-quality premix moldings. They can help you to better products at lower costs. For the names of molders and suppliers, contact your nearest Dow Sales office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. 2206F.

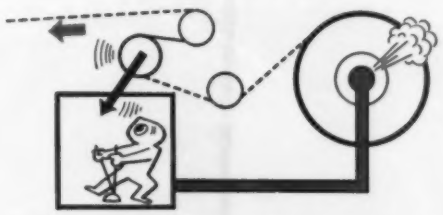
YOU CAN DEPEND ON DOW

check your unwind tension controls

For continuous profitable production at lowest possible cost in web-fed processing...

If you want more profitable production from high speed winders, slitters or web-fed printing and processing machinery, **first check your unwind web tension controls!** No matter what material you work with, remember this...a relatively low investment in a dependable Cameron unwind tension control system will protect your profits by permitting higher, more productive operating speeds...by improving the quality of your finished product...and by minimizing loss through snap-offs. A fully automatic Cameron tension control system can be custom-fitted to meet the exact requirements of the material, the speed and the web-fed process with which you are concerned.

CAMERON 900



Extraordinary range and sensitivity assures instant correction of extreme parent roll irregularities. Versatile range of **MODEL 900** provides constant tension on a wide variety of plastic films, foils and papers. In **MODEL 900,** the fully automatic brake pressure control mechanism is actuated by low-inertia, low-friction dancer roll which moves in a horizontal plane to provide slack take-up on the unwinding web. This system provides exceptional range for extreme correction problems.

CAMERON WEB-TROL*

A highly accurate, fully automatic web tension control system which provides extremely fast correction for many types of roll-fed printing and processing equipment, as well as for slitters and roll winders. In **WEB-TROL,** the brake pressure control mechanism is actuated by a sensing roll which moves .010" in a vertical plane. Vertical travel of the sensing roll is governed by variations in down-pull on the unwinding web as it slackens or tightens, due to parent roll irregularities. *patent pending

CAMERON CAMATROL*

A low cost, dependable, fully automatic system for maintaining constant web tension control. **CAMATROL** can be applied to many types of roll processing machines. With **CAMATROL,** the brake pressure control mechanism is actuated by an electric impulse which is governed by variations in load on the rewinding drive as the unwinding web slackens or tightens. *patented

Three systems to choose from!

IT PAYS TO START your processing run with dependable control of the unwinding web. Reduce your costs, improve the quality of your finished product, and get more profitable production at higher speeds by starting with a Cameron custom-fitted web tension control system. Replace old, inadequate controls now, and see the difference! Ask Cameron specialists to tell you all about **CAMATROL, WEB-TROL,** and **MODEL 900.** Write, wire or phone today.

Cameron Machine Company, Franklin Road, Dover, N. J.

Canada: Cameron Machine Co. of Canada, Ltd., 15 Hatt St., Dundas, Ontario
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AA-336

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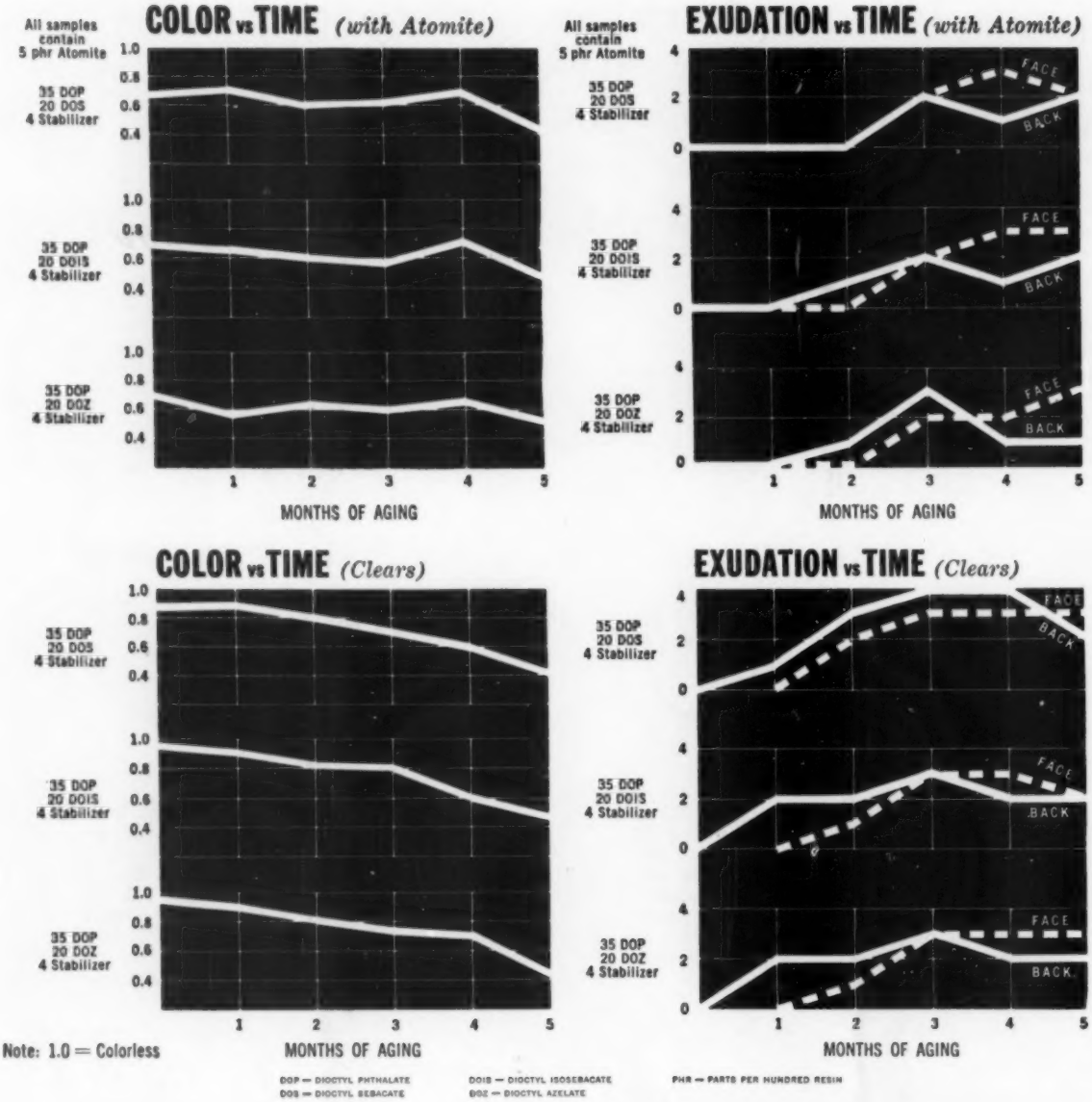

Note: 1.0 = Colorless

DOP — DIOCTYL PHTHALATE
DOS — DIOCTYL SEBACATE
DOIS — DIOCTYL ISOSEBACATE
DOZ — DIOCTYL AZELATE
PHR — PARTS PER HUNDRED RESIN

Florida aging tests show ester of **ISOSEBACIC® ACID** matches performance of other vinyl plasticizers ...and it is more economical

The dioctyl ester of ISOSEBACIC® acid matches the performance of more costly dioctyl sebacate and azelate as a plasticizer for vinyl resins. The evidence is provided by the above charts of a recent, independently conducted test.*

ISOSEBACIC acid is a new synthetic intermediate made by U.S.I. A mixture of three C-10 dibasic acids —2-ethyl suberic, 2, 5-diethyl adipic, and sebacic acids— it offers a number of interesting properties. Other uses include—intermediate for polyamides, polyesters, polyurethanes and alkyd resins.

ISOSEBACIC acid soon will be available in commercial quantities from U.S.I. at Tuscola, Ill. Price comparisons with competitive intermediates indicate that ISOSEBACIC acid will afford important savings.

This might be a good time to evaluate ISOSEBACIC acid for your operations. Send for data sheets and samples.

*Test results supplied through the courtesy of Deocy Products Co., Cambridge, Mass.

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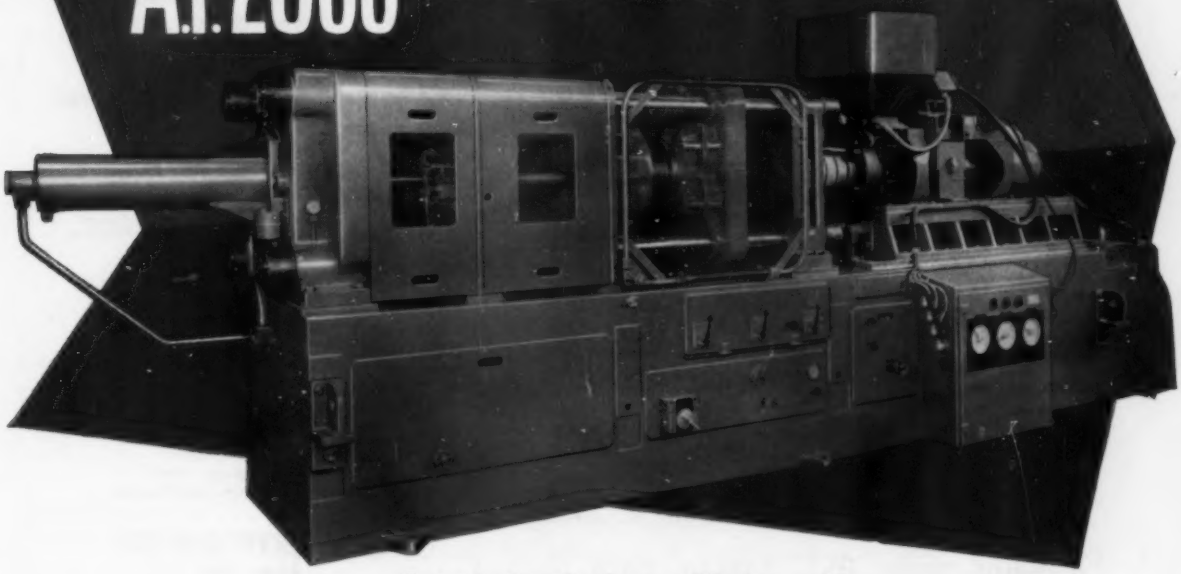
The WINDSOR

A.P.2088

PREPLASTICISES UP TO 300 lbs per hr. WITH SHOT CAPACITY OF 64 ozs.



THE WINDSOR RANGE INCLUDES INJECTION MOULDING MACHINES, in capacities of from 1 to 200 ounces, and EXTRUSION MACHINES up to 500 lbs output.

* *Fully descriptive literature available on request.*

Incorporating the famous Windsor multi-screw pre-plasticising unit, the AP2088 can be depended on for large outputs of quality mouldings.

- **For hand and semi-automatic cycle control**
- **In-line multi-screw pre-plasticising injection unit**
- **Capacity, or swept volume is 88 cubic inches of plasticised material per shot**
- **Locking pressure—500 tons**
- **Mould height adjustment by centre screw mechanism**
- **Completely self-contained**

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The Plastiscope

July 1958

News and interpretations of the news

By R. L. Van Boskirk

Section 1

New polystyrene producer. Cosden Petroleum Co. is now producing general-purpose and impact polystyrene in its new 22 million-lb. plant at Big Spring, Texas. The company claims that this plant, built by Blaw-Knox, is the first fully integrated operation used in production of polystyrene and that it will be the lowest-cost production facility in the industry.

The polymer plant follows construction of a 20 million-lb. monomer plant which came on stream in February 1957. Built by Badger Corp., the latter introduced a new concept in styrene production whereby one step is completely eliminated. In the Cosden plant, ethyl benzene is extracted directly from xylene in contrast to the conventional method where benzene is alkylated with ethylene. Ethyl benzene occurs naturally in xylene in proportions of 20 to 25%, but heretofore it has not been practical to extract it with sufficient purity for use in styrene.

The company has also initiated what is called a "curb-service marketing" system. Trucks with a 34,000-lb. load capacity and pneumatic unloading devices will deliver to gravity-feed hoppers at customers' plants. Storage hoppers permit customers to take instant inventory and eliminate unloading, warehousing, multiple handling, and contamination. Bulk prices are determined on a delivery-zone basis.

New general-purpose plasticizer. Monsanto Chemical is now marketing a new alcohol phthalate plasticizer designed to be used in many places where DOP is now conventional but selling at a lower price than DOP. Tradenamed Santicizer 165, it differs from most alcohol phthalate types in that it is the result of a chemical reaction rather than a physical blend. Its volatility is slightly higher than DOP but far lower than butyl octyl phthalate. It is suggested for vinyl applications where service conditions are not extreme and especially for floor coverings because of its resistance to staining by all sorts of solvents ranging from kerosene to mustard.

Monsanto is also adding a normal octyl decyl (n-octyl, n-decyl) adipate to its line. It will sell in the 40¢ area. It is a quality plasticizer with excellent low-temperature flexibility for upholstery, garden hose, outdoor jacketing for wire, and plastisols.

Neighbors for Spencer Chemical. Crown Zellerbach and Ludlow Papers, Inc., are now building extrusion facilities for production of polyethylene film next door to the Spencer resin plant at Orange, Texas. According to Frank L. Pyle, vice

*Reg. U.S. Pat. Off.

1 FIRST OF A SERIES

Chemical Division GENERAL THE GENERAL TIRE & RUBBER CO. VYGEN

THE GENERAL TIRE & RUBBER COMPANY
CHEMICAL DIVISION • AKRON, OHIO

INTER-OFFICE MEMORANDUM

FROM: Purchasing Department

TO: Chief Chemist

SUBJECT: VYGEN PVC RESIN

The General Tire Chemical Division representative just left, after giving me some information on their line of PVC resins. From what he says, they certainly will help solve some of our production problems. These resins have also been recommended to me at the Purchasing Agents' Meetings by users. The resins are as follows:

Vygen 110—An average molecular weight general purpose resin recommended for calendered film, sheeting and coated fabrics, as well as for extrusion and molding operations. This resin could solve the flaws in the surface that we have had lately, which you said was due to gelled particles.

Vygen 120—A high molecular weight resin primarily adapted for extrusion operations from dry blend or pelletized compound. It is said to have maximum heat stability and low gell count, and has been approved by the UL for electrical applications. Since it has this approval, and can be dry blended with polymeric plasticizers and extruded from the dry blend, it sounds like a natural for that new wire coating job you have been working on.

Vygen 105—A low molecular weight resin for molding, calendering, and extrusions requiring a high gloss finish. It has excellent heat stability, and should do the job in our injection molding setup.

Vygen 161—A low bulk density – high plasticizer absorption resin of average molecular weight, recommended for use where high plasticizer-to-resin ratios are required. It will give a dry pre-blend even in an unheated pre-blender, and is generally used to make pigment color masterbatches. Sounds like an easy way of adding our colors.

General is stressing these specialized resins, tailored to fit the job, and offers excellent service, as well as superior quality. With warehouses throughout the country, and a modern plant at Ashtabula, Ohio, they give overnight delivery almost anywhere, in either straight or mixed carloads. The versatility of these resins allows them to fit many of our operations. Please evaluate them, and send the results along to Production with a carbon to me.

N. B. Wagner
Purchasing Agent

The Plastiscope

(*Continued from page 37*)

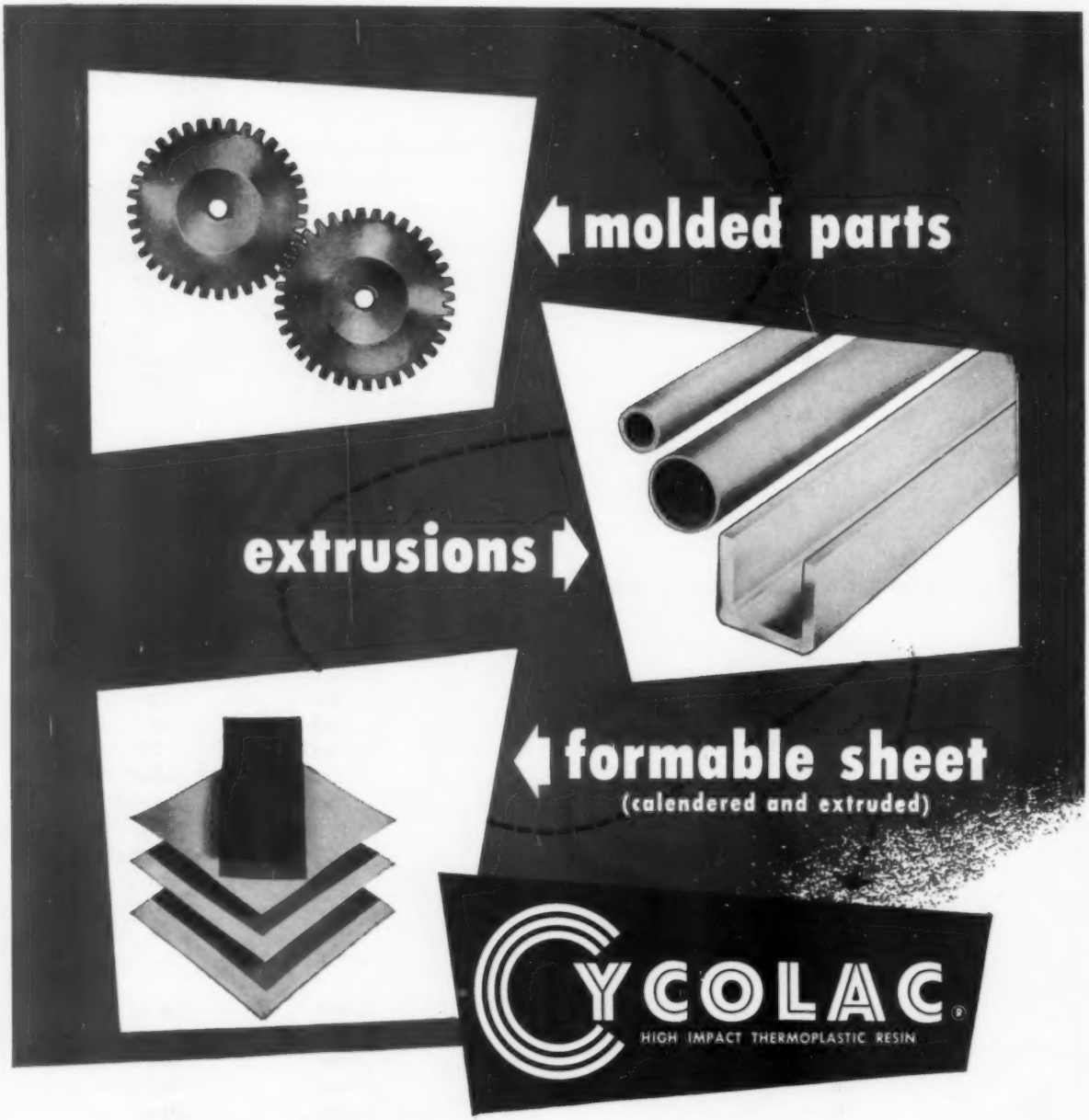
president of Spencer, these steps "re-emphasize Spencer's policy to market polyethylene through independent extruding companies rather than follow recent trends toward captive film production brought about by mergers." Crown Zellerbach recently announced a polyethylene film bread wrapper made from a medium-density Spencer resin and expects to add film as a new product to its diversified line of flexible packaging materials, such as waxed paper, foil, laminates, and polyethylene-coated paper. Ludlow, of Boston, recently created a plastics division to facilitate production and distribution of polyethylene-coated paper products and thermoplastic film. Location of the two new extrusion plants near a resin source is expected to benefit their overall operating procedure.

Expandable polystyrene applications. Braniff International Airways has reportedly ordered 1 million coffee cups molded of Koppers' expandable polystyrene beads. The molder is Crown Machine & Tool Co., Fort Worth, Texas. Advantages of this particular material are its low cost and its high insulation value which keeps the coffee hot and fingers cool. Price of expandable polystyrene beads was reduced to 37¢/lb. last April, but a most important cost factor is the small amount of material needed to do a given job.

Low-cost polystyrene film for tough jobs. Production of 1- to 2-mil polystyrene film for low-cost packaging uses would have been deemed highly impractical by most of the trade only 10 years ago. To produce a tough, flexible film inexpensively from a resin heretofore used primarily for hard and often brittle moldings is a difficult assignment. Small quantities of film under ½ mil have been produced for electrical purposes, and Plax has been making film or sheeting over 2 mils thick in sizable volume for some time, as well as a thinner film for laminating purposes, but has not generally channeled its material into the packaging market as yet. The real triumph achieved by Dow Chemical in production of its new, thin Trycite polystyrene packaging material may be summed up in one word—PRICE. For first news of this film, see MODERN PLASTICS 35, 43, April 1958, and the chapter on polystyrene in the January 1958 review.

Trycite film sells at 60¢/lb. and has a low specific gravity of 1.05. Price of the film will be 2.36¢ per 1000 sq. inches. A pound of the new material will yield 25,400 sq. in. of 1-mil film, compared with around 22,000 sq. in. for acetate at from 3.4 to 4.2¢ for 1000 sq. in., and cellophane that will yield from 19.5 to 21,000 sq. in. at from 3 to 3½¢ for 1000 sq. inches. Polyethylene is lower in cost than Trycite, but there is presently no intent to put the two materials into competition. Trycite is aimed at other markets, including some now supplied by cellulose acetate and cellophane, as well as fields hitherto untouched by plastics. For further details see page 190.

Florida welcomes rigid PVC pipe. May reportedly was the highest month for sale of resin for rigid PVC pipe and June may be even bigger. One reason is that Floridians in particular are finding that the pipe meets their needs. For example, the Cherry Plaza Hotel in Orlando is using 6-in. Kraloy PVC pipe



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The Plastiscope

(*Continued from page* 39)

for the risers that connect the cooling tower on the roof with the air-conditioning system; smaller-diameter pipe and Sloane fittings are used for connections to the Carrier units. Southeast Distributing Co., Miami, sold the contractor on the use of rigid vinyl because it reduced roof and floor loading weight and the plastic pipe could be installed by two men in the same time as it would take six men to install metal pipe. And, of course, the PVC pipe is corrosionproof.

The largest power company in Florida, located in Miami, is now reported to be using 3½- to 4-in. PVC pipe exclusively for new conduit installations and replacements. Plus advantages are that its smoothness permits easy pull-through when a new cable is added and it is not subject to underground galvanic action. Still other uses for the vinyl pipe are being found where chlorine and salt water pose problems for metals.

High-molecular-weight polyethylene. Allied Chemical, through its Semet-Solvay Petrochemical Div., has announced expansion of its polyethylene-producing plant at Tonawanda, N. Y. Included are facilities for producing the company's high-molecular-weight, high-density polyethylene which up to now has been used for pipe only by Orangeburgh Mfg. Co. Considerably more than 200,000 ft. of this pipe have already been installed in chemical plants. Manufacture of this type pipe has now commenced by Carlon Products Corp., Cleveland, Ohio, and it is assumed by the trade that this new polyethylene will soon be available for applications other than pipe. Allied's A-C high-molecular-weight polyethylene is reported to have quite different properties than other producers' high-density material. It is believed also that Allied has been developing methods of processing its resin to make it possible for molders and extruders to handle it just as easily as the lower-molecular-weight, high-density material of other producers.

The company has also announced a reduction in the price of its low-molecular-weight A-C polyethylene resins, grades 6A and 617A, which are powdered sizes. They are now 30¢/lb., the same price as the pellet size. The powdered sizes are reported to be easier to form and mix and to be more adaptable to use in some types of dry-blending machines and in multi-cavity molding; they are also used in the production of paper coatings, rubber, printing inks, and polishes.

Visit to Russia. A U. S. Plastics Industry team is now visiting Russia to compare notes and exchange technological information with plastics operators in that country. A Russian team will visit the United States next November. Members of the U. S. delegation are: C. Russell Mahaney, vice president of St. Regis Paper Co. and president of The Society of the Plastics Industry, Inc.; C. W. Blount, Bakelite; R. E. Burk, Du Pont; Wm. T. Cruse, S.P.I.; J. E. Fitzgerald, Brunswick-Balke-Collender; T. J. Kinsella, Barrett Div., Allied Chemical; V. V. Lindgren, American Cyanamid; J. J. O'Connell, Consolidated Molded Products; and Theodore Shevzov, Naugatuck Chemical, Div. of U. S. Rubber.

For additional and more detailed news see Section 2, starting on p. 190.

For Plastics – go to Worbla

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Celluloid in sheets, tubes and rods.

WOPAVIN

PVC (Polyvinylchloride) in calendered and pressed sheets, tubes, rods and profiles. Compounds for injection molding and extrusion.

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Cellulose Acetate in sheets, tubes and rods.

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Acetate powder for injection molding and extrusion.

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Nitrocellulose for lacquers and technical uses. Bleached linters

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Manufacturers of plastics for over thirty years.
Worbla-Plastics have proved their worth. So that you may see for yourself – we shall gladly provide you with samples.

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For Vinyl Electrical Insulation that Resists High Temperature at High Humidity...

PARAPLEX G-54

Formulators of vinyl compounds should be particularly interested in PARAPLEX G-54—vinyl compounds containing PARAPLEX G-54 are especially well suited for high-temperature insulation used under "wet" conditions. This new Rohm & Haas plasticizer was specifically designed to provide freedom from exudation (spew) on exposure to high humidity at elevated temperatures.

Vinyl compounds plasticized with PARAPLEX G-54 also show better volume resistivity . . . outstanding retention of elongation after high-temperature exposure . . . superior plasticizing efficiency . . . high dry dielectric strength and very good retention of dielectric strength after immersion in water . . . excellent resistance to copper corrosion . . . compatibility with stabilizing plasticizers . . . outstanding resilience.

For more detailed information about all Rohm & Haas plasticizers and their applications, send for *What You Should Know About* PARAPLEX *and* MONOPLEX *Plasticizers.*

PARAPLEX *and* MONOPLEX *are trade-marks, Reg. U.S. Pat. Off. and in principal foreign countries.*

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

▲ Polyester resin is poured into cured fiber glass preform in the mold of the press prior to molding finished product. Uniformity of Pittsburgh Fiber Glass Roving makes products strong and durable, keeps rejects low, saves money.

"We cut rejections in half, produced better plastic products with Pittsburgh Fiber Glass Roving"

—says Mr. Robert E. Mollman, Production Manager, Plastic Products Corporation, Bedford Heights, Ohio

"The consistent uniformity we obtain from Pittsburgh Roving enables us to produce quality flower boxes, jardinieres, bird baths, mail boxes and laundry tubs that have fiber glass reinforcing through and through, especially at the corners," reports Mr. Mollman.

"When we began manufacturing three years ago, we tried a variety of fiber glass roving. Lack of roving uniformity from ball to ball caused a high rejection rate. But through this trial period, we discovered that Pittsburgh Type 610-60 Fiber Glass Roving produced more uniform preforms and permitted us to make strong and durable products. Using Pittsburgh Roving exclusively reduced our rejection rate very substantially.

"The dimension uniformity of Pittsburgh Roving is consistent from shipment to shipment. As a result, our operations are more profitable, we fulfill our obligations to customers and we make more efficient use of our materials."

HAVE YOU TRIED PITTSBURGH ROVING?

There's a type of Pittsburgh Fiber Glass Roving that's just right for your reinforced plastic operations. We'll be glad to help you get uniform results by working with you right in your own plant. For technical assistance, call your nearest PPG Sales Office, or write direct. *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.*

PITTSBURGH ROVING IS A PRODUCT OF THE FIBER GLASS DIVISION OF PITTSBURGH PLATE GLASS COMPANY

Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh and St. Louis

75th ANNIVERSARY 1883—1958 PPG

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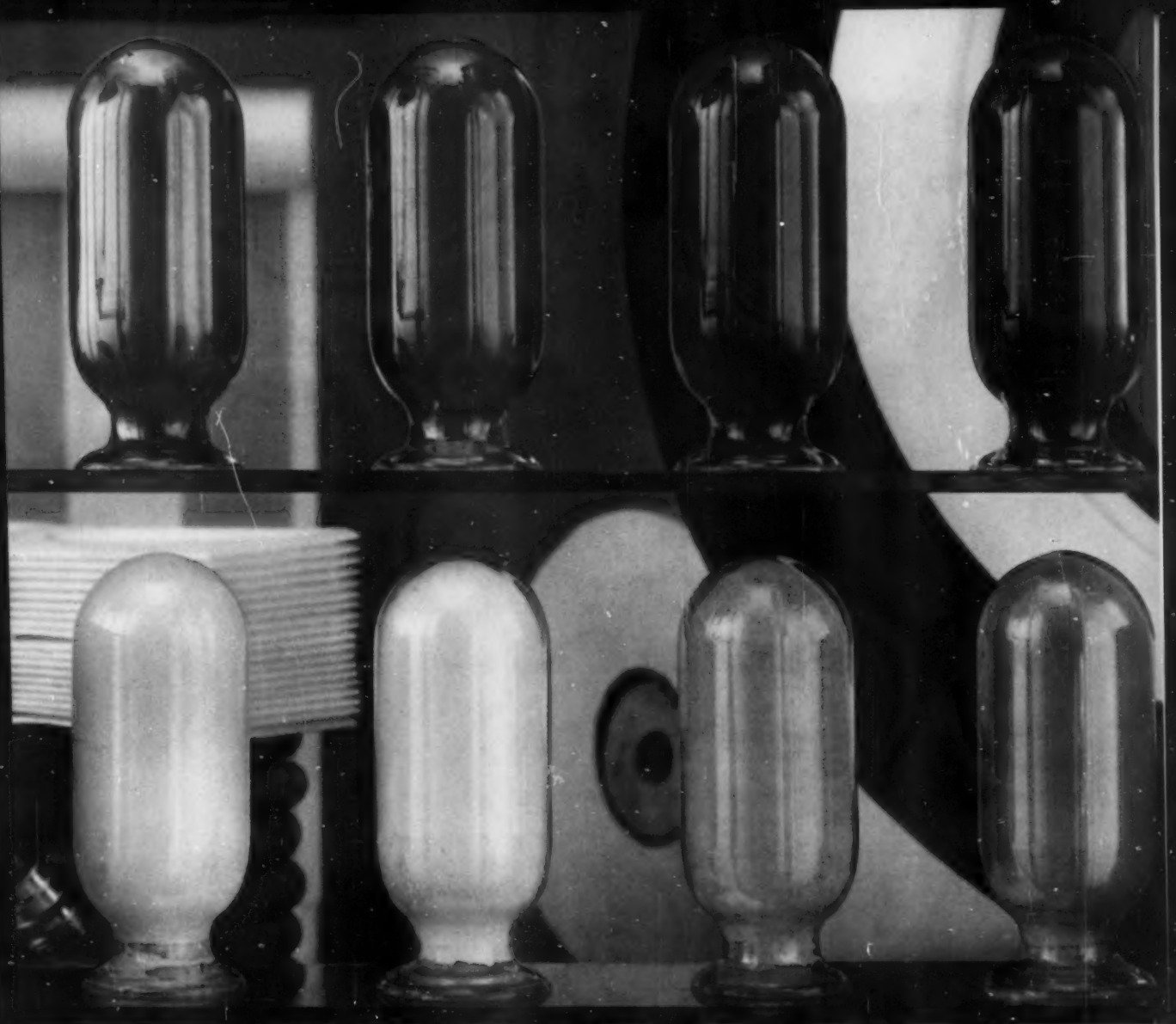

PIGMENTS

How to get the whiteness or color brightness you demand for your plastic products

Glidden pigments are the answer. New *Zopaque* Titanium Dioxide imparts greater lasting whiteness, permits brighter, cleaner tints. Finer, more uniform particles disperse much faster, more easily than ordinary pigments. Millions of tiny crystals scatter light like diamonds, assure highest opacity.

Non-fading, non-bleeding Glidden *Cadmolith* (cadmium-selenium) Reds and Yellows plus new *Mercadmolith* (cadmium-mercury) Reds provide everything you need to give your products maximum color appeal. They are soft, easy to grind, insoluble in all vehicles, and high in heat resistance.

Be sure to specify Glidden—a leading supplier of finest pigments to industry.

By the makers of Sunolith Lithopones . . . Euston White Lead . . . Resistox Copper Pigments

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Chemicals • Pigments • Metals Division

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....NOW....

MOLD THEM ALL AT LOWER COST ON THIS ONE!

THE NEW, 4-IN-ONE

"UNIVERSAL" MINI-JECTOR®

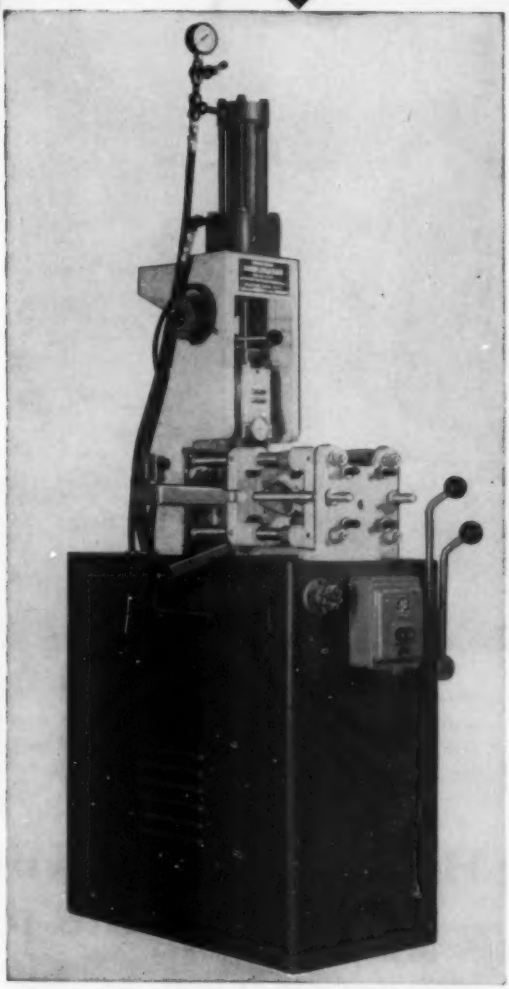
Reg. U.S. Pat. Off.

Plastic Injection Molding Machine

- ★ **More Features**—Combined advantages of all 4 top standard model MINI-JECTORS into one "do-all" machine.
- ★ **More Versatile**—Interchange molds: Straight-block "Hornet" type (for conventional molding), V-block "Wasp" type (for inserts and encapsulating).
- ★ **More Economical**—Small, parting-line sprued molds (blanks as low as $29.50). Big savings in manhours, equipment, and delays where big-press tooling can be avoided.
- ★ **More Flexible**—Interchange mold clamps: Hydraulic power for conventional production. Hand clamp Ass'y included as an extra for larger insert molding and sample development.
- ★ **Mold Nylon**—Adapter Assembly for finest conventional and insert molding in Nylon.
- ★ **Easy to Operate**—No special knowledge or skill needed for efficient operation.

New, Feature-Packed "UNIVERSAL" MINI-JECTOR . . . Your one machine for complete, variety molding up to 1 oz. Conventional and Insert.

One machine does it all! Eliminates expense of extra equipment and machines; saves high "per-piece" costs of big-press tooling where not required. Ideal for developing and producing widest varieties of small injection molded parts; from precision miniatures to full-size, single cavity items up to 1 oz. Features both conventional production and intricate insert molding in all thermoplastics, including Nylon. Most versatile, flexible machine of its type—at the lowest cost. Adapts quickly, easily to all variables in your most diversified plastic item programs. Learn how the multi-feature "Universal" can be the "work-horse" in your plant for small plastic parts. Write today.

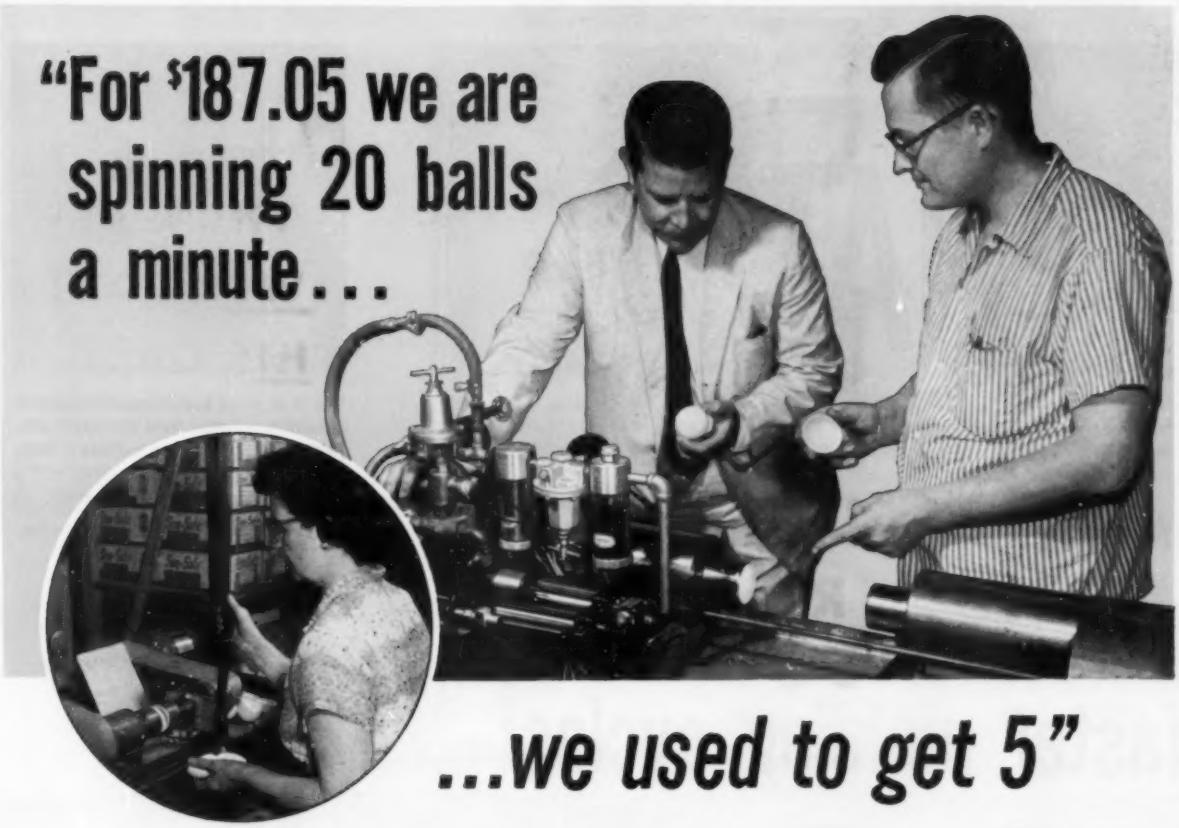


"Universal" MINI-JECTOR—combines features of "Super Hornet", Special Mod. 50 "Wasp", Mod. 60 HC75, and "air-JET". Includes adapters and accessories for development and production of virtually all plastic injection molding of variety items to 1 oz. capacity.

See Complete MINI-JECTOR Line of Machines and Accessories. Illustrated catalog details specifications; technical data on performance, applications, etc. Shows how MINI-JECTOR modernizes methods in hundreds of plants. Mailed free at your request.

NEWBURY INDUSTRIES, Inc.
Box 395, Newbury, Ohio

"For $187.05 we are spinning 20 balls a minute...



...we used to get 5"

The Brittain Products Company of Cuyahoga Falls, Ohio, developed a process whereby polyethylene shells are spun in opposite directions, their edges brought together until the friction heat bonds the halves, forming a perfect ball.

Controlling the process by hand . . . as shown in the photo of a woman operator moving the spinning heads together with a hand lever . . . was slow, inconsistent. The production rate was 5 balls per minute, spoilage was as much as 50% depending on the operator's sense of timing. Either too much or too little friction time caused an unsatisfactory bond.

Seeking a positive method of controlling the dwell time of the spinning shells, Brittain Products selected a Bellows Air Motor as a means to bring together and retract the spinning heads which are belt driven by separate electric motors. To provide precision control of the forward stroke of the Air Motor, a Bellows Hydro-Check was mounted parallel to the Air Motor. A Bellows Hydro-Check is a self-contained hydraulic unit which provides accuracy and smoothness to the fast action of the Air Motor. Several limit switches and an air filter completed the $187.05 Bellows equipment cost.

In operation, Brittain Products' patented "Ball Sealing Machine," as it is called, requires the operator's attention only to place the shells in the constantly spinning heads (start and stop switches for the electric motors are separate controls) and depress a button-switch with each hand to actuate the Air Motor.

This unique application of Bellows "Controlled-Air-Power" is typical of the way ingenious methods engineers apply Bellows air-powered devices to a wide range of operations. Whether the operation calls for the conversion of existing hand operated equipment to fast automatic or semi-automatic units, or the development of equipment designed for a specific job, Bellows work units will save design time and machine building costs.

Phone your Bellows Field Engineer (he's in the book under "The Bellows Co.") — ask him to show you the many ways in which Bellows "Controlled-Air-Power" Devices can help you cut production costs.

891-B

Or write direct for Bulletins ML-3 and BM-25. Address Dept. MP-758, The Bellows Co., Akron 9, Ohio. In Canada—Bellows Pneumatic Devices, Ltd., Toronto, Ontario.

The Bellows Co.
AKRON 9, OHIO

For whatever thermo-plastic you mold . . . polyethylene . . . . .

NATCO

This 16 oz. waste basket molded in less than 30 seconds is typical Natco 400 polyethylene production. Color change in less than 10 shots. Rejects less than 1%. Perfect dry coloring. You can't beat Natco's high speed injection, big shot capacity, high melt output.

INJECTION MACHINES GIVE YOU:

faster molding cycles: more parts per shift:

trouble-free operation: free of costly downtime:

higher quality parts: color, finish, strength:

Natco is truly "a molder's molding machine" designed to give you greater speed with complete dependability. Each production unit incorporates major engineering features, many of which have never been available before!

- *Fast injection, fastest clamp action ever offered*
- *Patented shockless closed-circuit hydraulic system*
- *Two speed injection control, independent of pressure*
- *Dual injection pressure system for strain-free parts*
- *Accurate control over speeds, temperatures, pressures*
- *Choice of 20,000 or 30,000 psi interchangeable plungers*
- *Automatic dual voltage heating system*
- *Lots of daylight and stroke for deep parts*
- *Big capacity "leakproof" heating chamber*
- *Built-in "extra" power units for double speed*

The most profitable decision you can make is to put Natcos to work in your molding shop. Buy now! Every day on the job your Natcos will meet the tightest production deadlines, give consistent high quality results. And they'll work around the clock, without costly downtime.

Ask one of our nearby plastics engineers to tell you what new Natcos can do for you. Write for catalog, illustrating all the features of this new line of injection machines.

..... polystyrene ..... acrylics ..... cellulosics

Seventy radio cabinets per hour . . . 21½ oz. shot. Natco's 400 kept rejects below 1%! Two speed injection, big platens, high speed injection, lots of plasticizing capacity, precision built ejector (vertical or horizontal), prepack, add up to profitable polystyrene production with Natcos.

This Natco 400 molds acrylic bus lenses 42% faster. Natco's variable displacement pump provides accurate injection speed control—no flow control valves used ! Choice of 20,000 or 30,000 psi plungers. Heating chamber has ideal flow conditions, low pressure drop. There's plenty of mold clamp pressure.

Telephone housing production proved the Natco is ideal for molding cellulosics. Excellent heat control—without "hot spots", fast color change, fully adjustable speeds and pressures with accurate plunger cushion control. No idle cycle time guarantees top production output.

The complete Natco Line includes . . .

	NATCO 300	NATCO 400	NATCO 400X	NATCO 800	NATCO 800X
Shot Size, Ozs.—Single Feed	22	28	28	85	85
Melt Capacity (lbs./hr.)	130	165	165	350	350
Platens (inches)	33 x 33	38 x 38	38 x 38	55 x 55	55 x 55
Clearance Between Rods	21½ x 21½	25 x 25	25 x 25	36½ x 36½	36½ x 36½
Clamp Tonnage (max.)	325	*425	*425	850	850
Clamp Stroke (max.)	24″	26″	26″	**40″	**40″
Daylight Opening (max.)	42½″	50″	50″	85″	85″
Injection Speed (cu.in./min.)	1125	1140	2280	2000	4000

*Also available with 550 ton clamp. **Also available with 55″ stroke.

PLASTICS MACHINERY DIVISION

National Automatic Tool Co., Inc.

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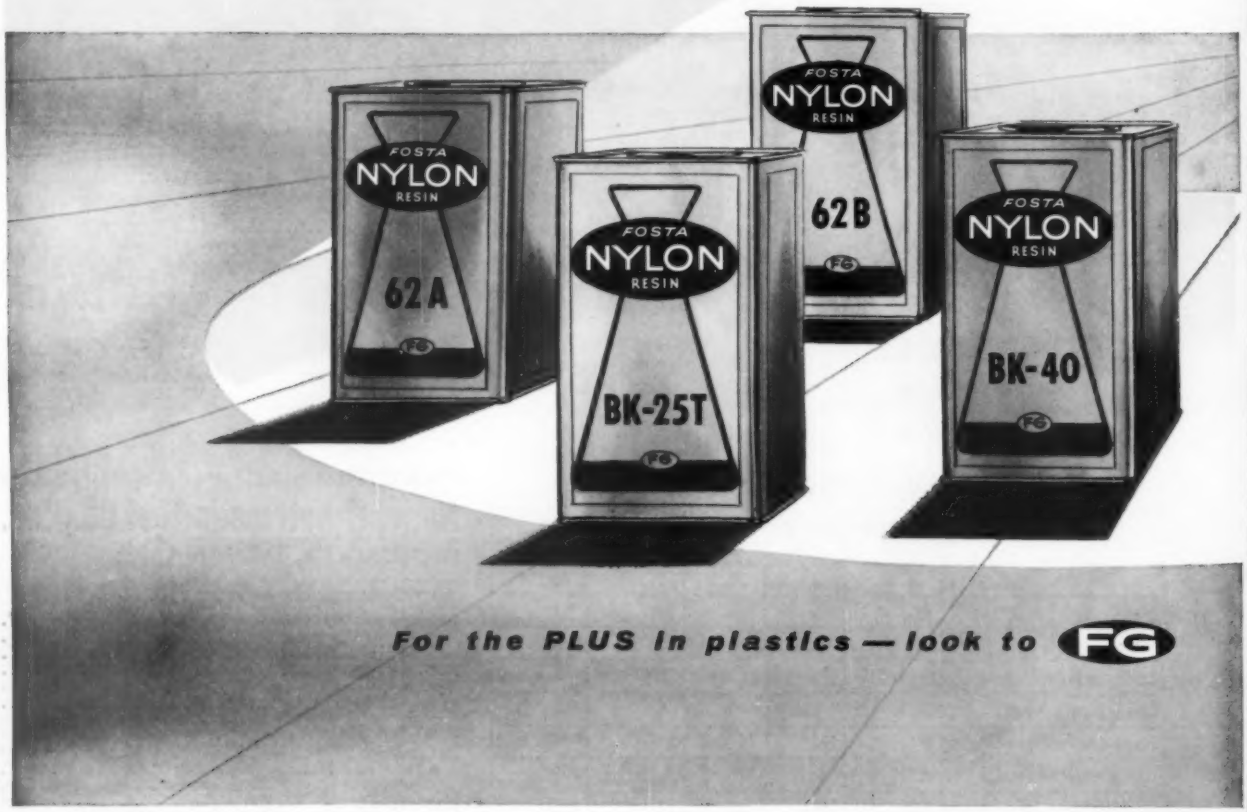
FOSTER GRANT
Announces:
FOSTA®

The growing preference for nylon products in both consumer and industrial applications has created important, new markets for the plastics industry. To help the molder and extruder meet this increasing demand, Foster Grant offers a complete range of nylon materials — five grades, custom compounded for the specific requirements of the end product, and for maximum efficiency in production.

As always, the industry may look to Foster Grant for *production proved,* quality materials and for production assistance based on 40 years' experience as a pioneer in the plastics industry.

To learn more about Fosta Nylon and its potential for you, write for our new, informative brochure, "Fosta Nylon — Its Role in Your Operations."



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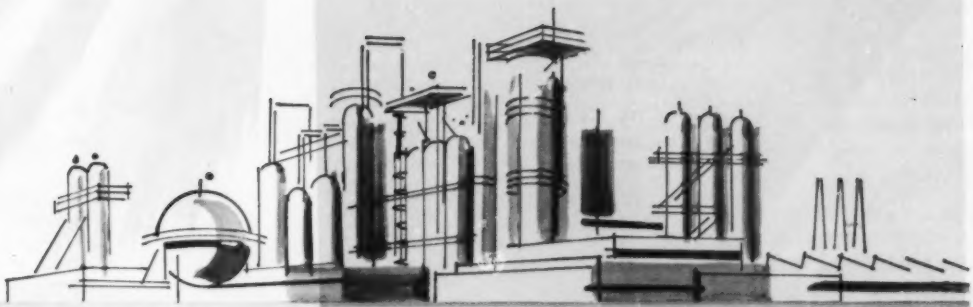

In Formulations to Meet Every Need for Molding and Extrusion

- **FOSTA NYLON 62A**
  A general purpose molding grade nylon with optimum flow properties. For large section moldings such as cabinets, appliance housings, containers.
- **FOSTA NYLON 628**
  Medium viscosity general purpose molding grade nylon with improved physical properties. For medium and small injection molded items such as combs, tumblers, gears, gaskets and novelties.
- **FOSTA NYLON BK-25T***
  A transparent molding grade nylon used where clarity in thin sections is desirable. For food containers, transparent packages, etc.
- **FOSTA NYLON BK-31***
  In graphite (G) and molybdenum disulfide (Z) types for antifriction applications such as bearings, gears, cams and sliding components.
- **FOSTA NYLON BK-40***
  An extrusion grade nylon in general purpose (F), transparent (T) and flexible transparent (R) types for pipe, tubing, film, tarpaulins, raincoat material and profiles.

**Made under license with Farbenfabriken Bayer, Leverkusen, Germany.*

FOSTER GRANT CO., INC.
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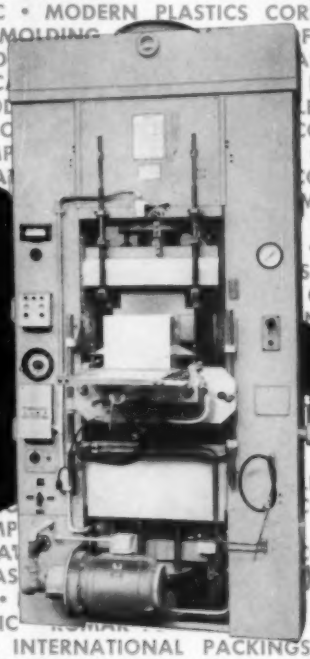
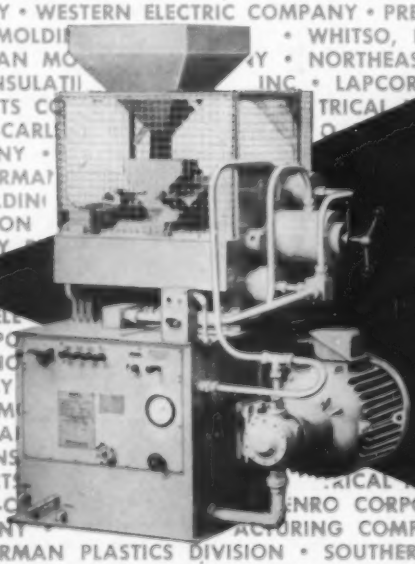
FOSTER GRANT also manufactures famous FOSTARENE and FOSTA TUF-FLEX High Impact Styrene.

Demand!

Proof of Bipel acceptance are the dozens of American manufacturers who depend on their Bipel equipment. Fast-operating, efficient, and economical, Bipel Thermosetting Molding Presses, Preformers . . . and even *complete systems* for hydraulic molding . . . have lived up to their superb reputation. Worldwide, Bipel leads the field with over 250 installations in 24 countries. Individual or multiple units with central drive systems . . . fully-automatic, semi-automatic or manual operations . . . a wide selection of speeds, capacities and pressure . . . give smart molders the essential flexibility and dependability that modern productions demands.

Shown right, for example, is the new fully-automatic Bipel Compression/Transfer Press. Available in a choice of pressures up to 71 or 168 tons maximum, this unit requires no more floor space than a standard press with operator. With top or bottom ejection, tool height is adjustable, and operation may be changed to semi-automatic or manual at the flick of a switch!





The popular standard Bipel Horizontal Hydraulic Preformer (left) is available in 4 models, ranging from 13 to 155 tons max. pressure. Fast, clean and quiet, it delivers preforms with remarkably uniform density, weight and preheating! Initial and maintenance costs are very low. For small preforms, multi-punch versions are capable of producing up to 25,000 preforms per hour!

Service is a measurement of value, and in this Bipel is again unexcelled. A complete stock of replacement parts is maintained at all times in Tiverton, R. I. Expert technicians are available for servicing or consultation at a moment's notice. Demonstrations may be arranged anytime by appointment. Why not plan to stop in the next time you're near New England?

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Why SHOULDN'T I be interested in business life insurance?

"Our future depends on the future of my husband's business."

Every businessman — owner, partner, stockholder — has a vital stake in the future of his business . . . and his family may face real hardship *unless* he has prevented possible financial disaster through sound business planning.

One of the greatest hazards can be death of an owner of the business. Ætna Life's Business Planning Service can be instrumental in protecting your family's future security when this happens.

Thoroughly trained representatives in 91 agencies from coast to coast offer you and your attorneys this essential planning service.

ÆTNA BUSINESS LIFE INSURANCE PLANS ARE SPECIALLY DESIGNED . . .

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Please send me a copy of your new business life insurance booklet "Will This Man Take Your Business With Him When He Dies?"

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Can it be sleeping that's making you tired?

. . . Time to wake up and let PEERLESS show you what's new in Plastics Marking.

We at PEERLESS have developed a roll leaf that resists wear . . . oil and alcohol stain . . . perspiration . . . and most every type of punishment possible.

PEERLESS Roll Leaf Company has marked practically every type of plastic . . . has made equipment for marking most every size and shape of plastic product . . . and continues to be first in their field with new advancements in plastics marking, and the manufacture of plastics marking machinery.

Come on now, sleeping is all right at home, but not during a working day . . . wake up . . . call or write PEERLESS . . . let us tell you "what's new".

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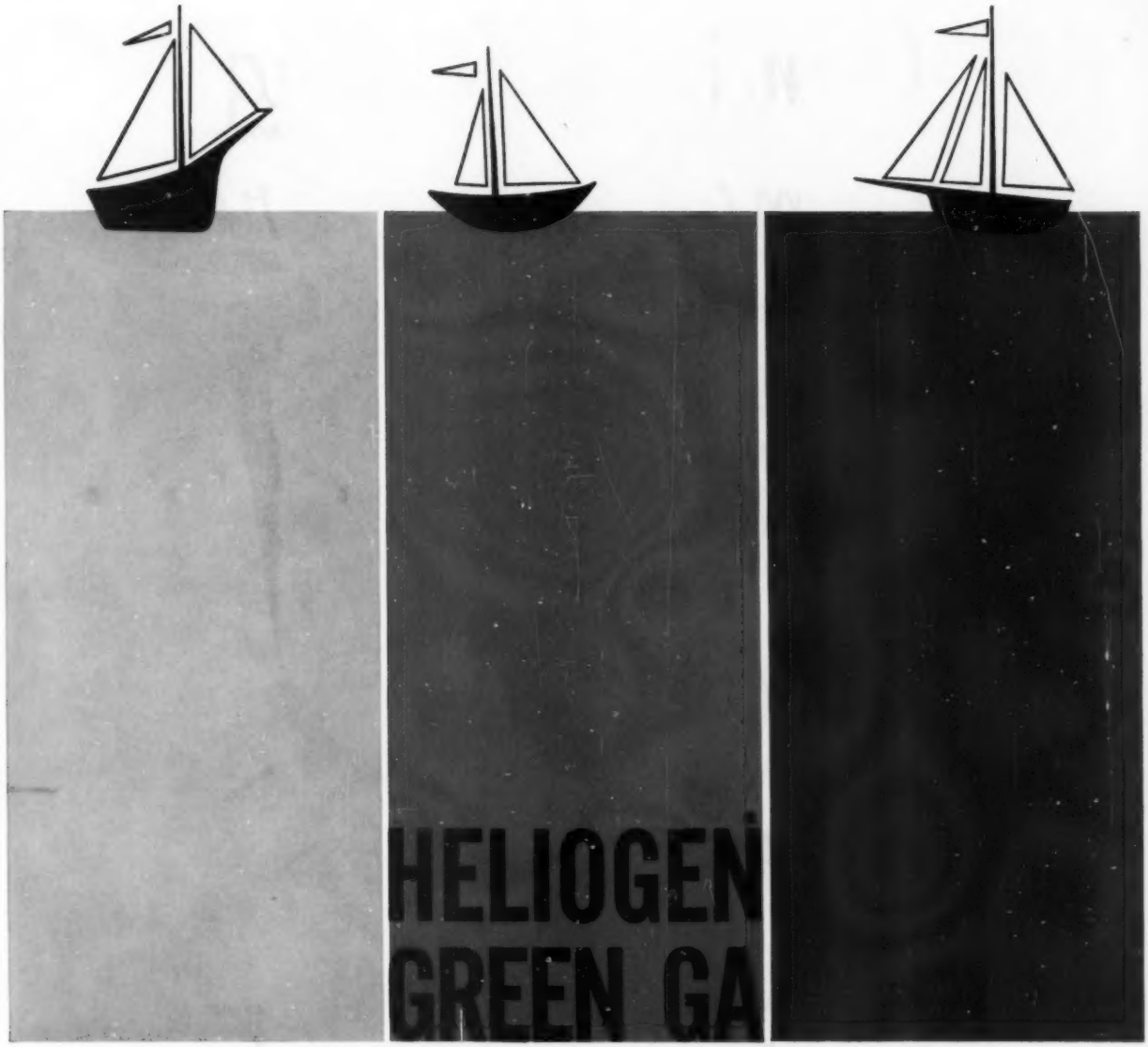

VIVID AND LIGHTFAST IN PASTEL OR FULL SHADES

In plastics, inks and paints, GDC's Heliogen Greens exhibit excellent lightfastness in all degrees of tint. A phthalocyanine pigment of high tinctorial strength, Heliogen Green is supplied in a variety of powder, paste, and presscake forms as well as shades to meet the requirements of different applications.

Besides outstanding fastness to light, the Heliogen Greens display remarkable stability to acids, alkalis, aromatic solvents, aliphatic hydrocarbons, alcohols, ketones, esters, turpentines, varnishes, and vegetable and mineral oils.

Available as: Heliogen Green GA—Standard Shade • Heliogen Green GB—Blue Shade • Heliogen Green GY—Yellow Shade

Write or call the GDC office nearest you for further information and technical assistance.

FROM RESEARCH TO REALITY

gdc gaf

PIGMENT DEPARTMENT

GENERAL DYESTUFF COMPANY

A SALES DIVISION OF

GENERAL ANILINE & FILM CORPORATION

435 HUDSON STREET · NEW YORK 14, NEW YORK

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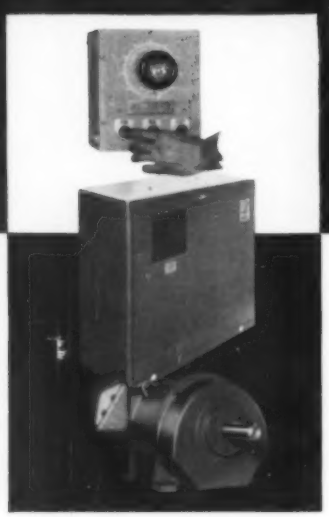
Photo courtesy Radix Wire Co.



PUT MORE PRODUCTIVITY INTO YOUR EXTRUDER WITH A RELIANCE V*S DRIVE

The productivity of an extruder depends upon how many shapes and forms it can turn out, and how many types of materials it will extrude. A Reliance Variable Speed Drive will put maximum productivity into your extruder.

With the wide speed range of a V*S Drive, a single extruder can accommodate a variety of dies. Speeds can be automatically controlled or manually adjusted.

The unique horsepower and torque characteristics of a Reliance Drive can handle a broad assortment of materials. Anything from rigid vinyls to pliable polyethylene can be extruded on a single machine with a V*S Drive!

To put more productivity and profitability into your next extruder, be sure to specify a Reliance V*S Drive when you order.

For further details contact your local Reliance representative, or write today for Bulletin No. D-2506. D-1588

RELIANCE ELECTRIC AND ENGINEERING CO.

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VIVID AND LIGHTFAST IN PASTEL OR FULL SHADES

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Available as: Heliogen Green GA—Standard Shade • Heliogen Green GB—Blue Shade • Heliogen Green GY—Yellow Shade

Write or call the GDC office nearest you for further information and technical assistance.

FROM RESEARCH TO REALITY

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PIGMENT DEPARTMENT
GENERAL DYESTUFF COMPANY
A SALES DIVISION OF
GENERAL ANILINE & FILM CORPORATION
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Photo courtesy Radix Wire Co.

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With the wide speed range of a V•S Drive, a single extruder can accommodate a variety of dies. Speeds can be automatically controlled or manually adjusted.

The unique horsepower and torque characteristics of a Reliance Drive can handle a broad assortment of materials. Anything from rigid vinyls to pliable polyethylene can be extruded on a single machine with a V•S Drive!

To put more productivity and profitability into your next extruder, be sure to specify a Reliance V•S Drive when you order.

For further details contact your local Reliance representative, or write today for Bulletin No. D-2506. D-1588

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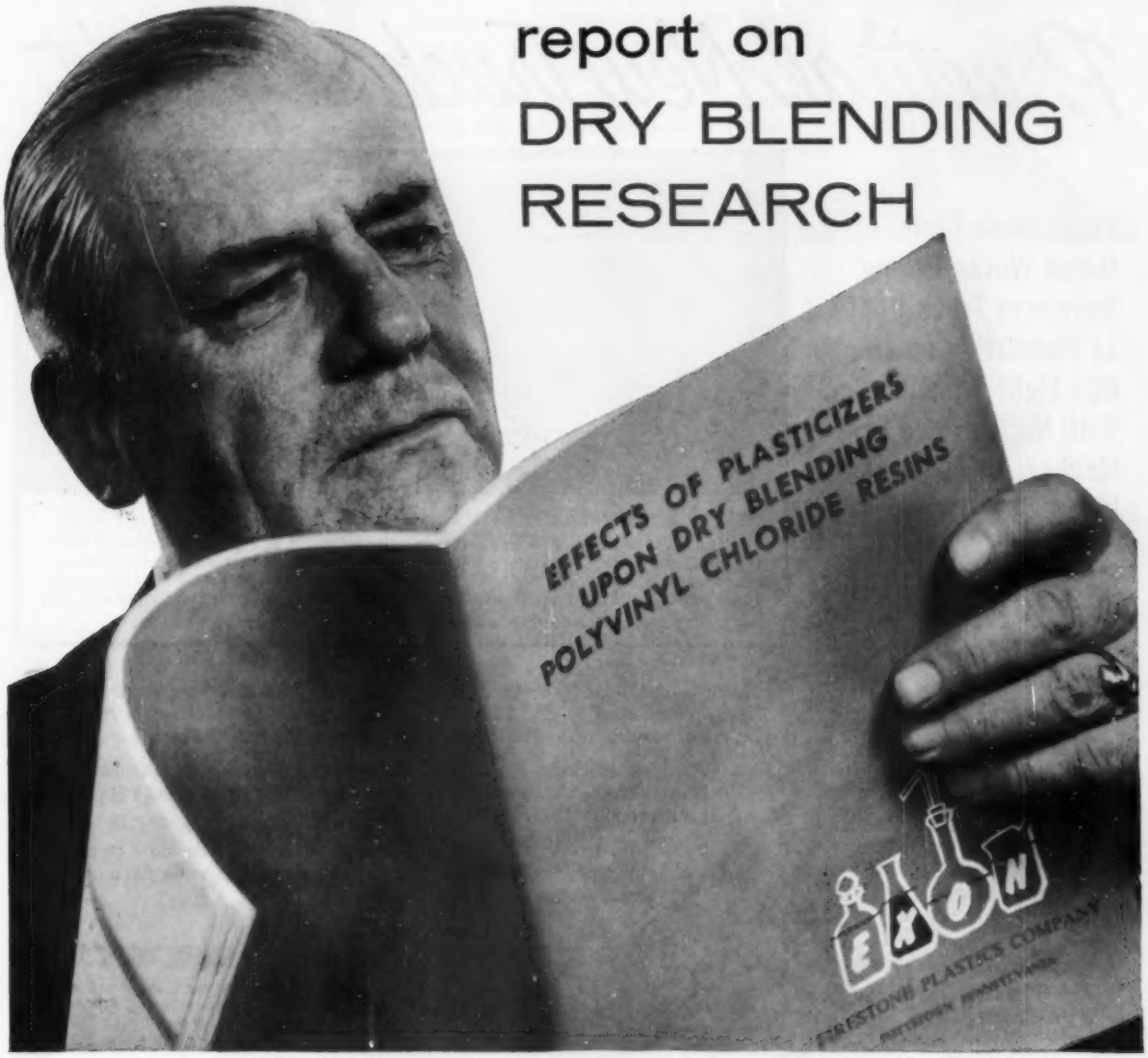
An instructive NEW report on DRY BLENDING RESEARCH



Firestone

EXON

RESINS

Today few industries are benefiting from as much technical research as is the plastics field. New applied knowledge steadily streams from Firestone's laboratories.

In order to help the busy plastics engineers keep abreast of basic developments in his field, the Firestone Plastics Company, from time to time, publishes booklets on its findings. One of the latest is "Effects of Plasticizers upon Dry Blending Polyvinyl Chloride Resins."

The information contained in this comprehensive booklet will help you solve many of your product and production problems. Fill out the coupon below. Your copy of this booklet will be mailed to you promptly.

FIRESTONE PLASTICS COMPANY
Dept. 82J, Pottstown, Pennsylvania

Please send me, at no cost, a copy of: "Effects of Plasticizers upon Dry Blending Polyvinyl Chloride Resins"

Name_____

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Company_____

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INDUSTRY'S MOST COMPLETE LINE OF VINYLS ENGINEERED TO YOUR SPECIFIC NEEDS

Garan® ROVING & RESIN
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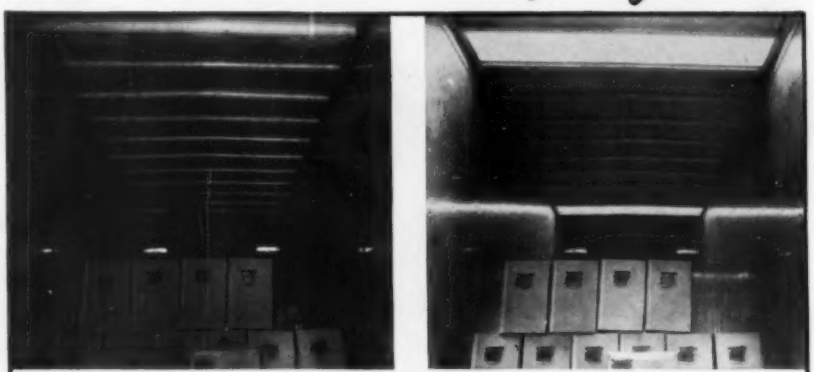
Practical New Truck Skylight

Panel Made From Garan Woven Roving Increases Truck Utility by Permitting up to 60% Light Transmission With No Sacrifice of Mechanical Strength in Roof



HERE'S POSITIVE PROOF*

Photograph at left was taken with skylights covered. Front roof caps were left uncovered and one rear door open 12". Light meter reading of 0.2 candle power.

Photograph at right was taken of same trailer with one rear door sealed and second open one foot. No artificial light used. Light meter reading was 3.2 candle power.

*Unretouched photographs taken by Fruehauf Trailer Company, Detroit, Michigan.

Garan Woven Roving produces laminates having uniformly high physical properties.

Fiber Glass Industries, Inc., Amsterdam, N. Y. produces Polyply Skylights in widths of 19 and 25 inches, in lengths of 90 to 94 inches with three layers of resin bonded ROVCLOTH molded to the panel's metal frame.

Another efficiency problem in multi-stop trucking operations has been solved—thanks to the unique characteristics of Garan Roving, pioneered by L·O·F Glass Fibers Company.

Diffused light into truck trailer working areas now permits sorting, checking and delivery organization without moving items to the door for label reading.

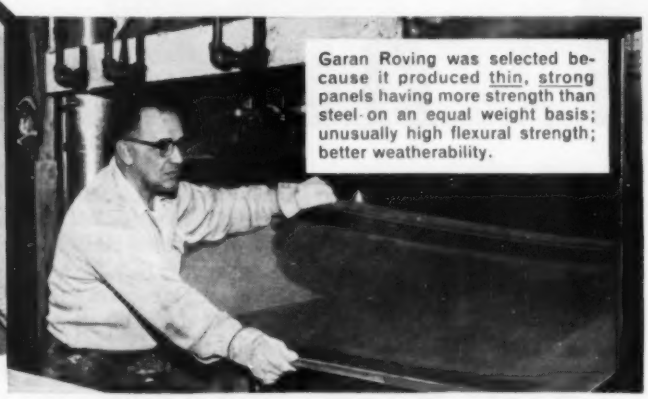
WITH GARAN WOVEN ROVING YOU GET:

faster wet-out . . . better bond . . speedy production.

improved flexural, compressive and tensile strengths.

high wet-strength retention . . . added durability.

Because Garan Roving is made by the marble process, it permits clearer, color-free laminates . . . a feature of great importance in applications where translucency is required.



Garan Roving was selected because it produced thin, strong panels having more strength than steel on an equal weight basis; unusually high flexural strength; better weatherability.

L·O·F GLASS FIBERS

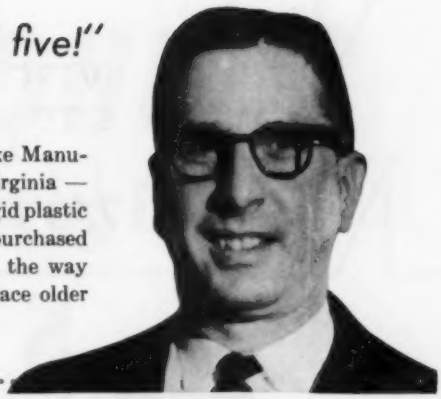
For technical information about Garan Roving and how it can help improve your product . . . open new markets, call our nearest sales office, or write: L·O·F Glass Fibers Company, Dept. 15-78, 1810 Madison Avenue, Toledo 1, Ohio

L·O·F GLASS FIBERS COMPANY
TOLEDO 1, OHIO

"Three new **REEDS** *take the place of five!"*

man

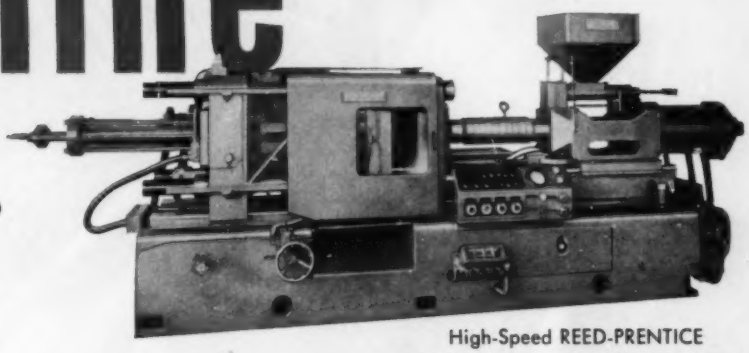
. . . . . who said it



George Kissak, President of Hake Manufacturing Co., Inc., Roanoke, Virginia — world's largest molder of small rigid plastic display boxes — says, "We have purchased three 8 oz. and five 12 oz. REEDS during the past two years, and the way these REEDS perform, we will continue to buy REEDS either to replace older ones or add to our equipment."

machine

. . . . that makes it possible



High-Speed REED-PRENTICE
Plastic Injection Molding Machine

REEDS *offer you . . .*

Low Cost Molding
. . . High speed produces up to 2200 containers an hour!
Fully Automatic Direct Feed
. . . to production or packaging line.
Greater Versatility
. . . long stroke REEDS handle deep-draw containers.
Rugged Construction . . . REEDS are built to take high-speed *continuously.*
Low Maintenance Cost . . . simplified design makes all parts easy to get at.

products

. . . *of Hake Manufacturing* made with REED 4 oz., 8 oz. and 12 oz. machines. "Operating with modern equipment gives the best molding conditions which result in the best products," says Mr. George Kissak.

Write to us and we will send you full information on the cost-saving Reed-Prentice Plastic Injection Molding Machine.

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Division of PACKAGE MACHINERY COMPANY

EAST LONGMEADOW, MASS.

BRANCH OFFICES: New York • Cleveland • Chicago • Buffalo • Dayton • Dearborn • Kansas City • Los Angeles

NEW 2 RIGID For pipe

These rigid vinyl compounds just announced by Bakelite Company *outperform any other rigid vinyl on the market today!* Greater resistance to chemicals—better heat stability—*as much as 100% faster extrudability, with better surface smoothness*—all these, and other advantages are offered by both materials.

QGD-5020, a modified Type II rigid vinyl, offers a new, high impact strength, making it *one of the toughest plastic materials commercially available.*

Both materials are exceptionally free-flowing. QGD-5010, with outstanding chemical inertness, will find widest application in commercial and industrial corrosion-resistant pipe.

In addition to standard pipe applications, the QGD-5020 compound is a superior general purpose extrusion material for contour applications such as channels and framing members for windows and storm sash, electrical conduits, down spouts and gutters, fountain pen and automatic pencil barrels, and many more!

★ ★ ★

Complete details on both compounds are given in new technical bulletins. Write today to Dept. MP-032.

VINYL COMPOUNDS

and all-purpose extrusion

Extrudability!

TYPICAL PROPERTIES	QGD 5010	QGD 5020
Specific Gravity	1.38	1.313
Heat Distortion, deg. C.	70	69
Izod Impact	.6	24 - 30
Rockwell "R"	115	107
Tensile Strength, psi	8500	6500
Elongation, %	50	30
Flexural Strength, psi	11,800	10,000
Flexural Modulus, psi	450,000	357,000
Chemical Resistance, 30 day immersion test		
in H_2SO_4, % change in flex. str.	+ 9.94	+ 3.8
in H_2SO_4, % change in wt.	+ .08	+ .452
in Glacial Acetic Acid, % change in flex. str.	— 42.7	— 68.
in Glacial Acetic Acid, % change in wt.	+ 7.41	+ 17.8

BAKELITE BRAND **RIGID VINYLS**

Products of UNION CARBIDE *Corporation*

BAKELITE COMPANY, *Division of Union Carbide Corporation,* 30 East 42nd Street, New York 17, N. Y.
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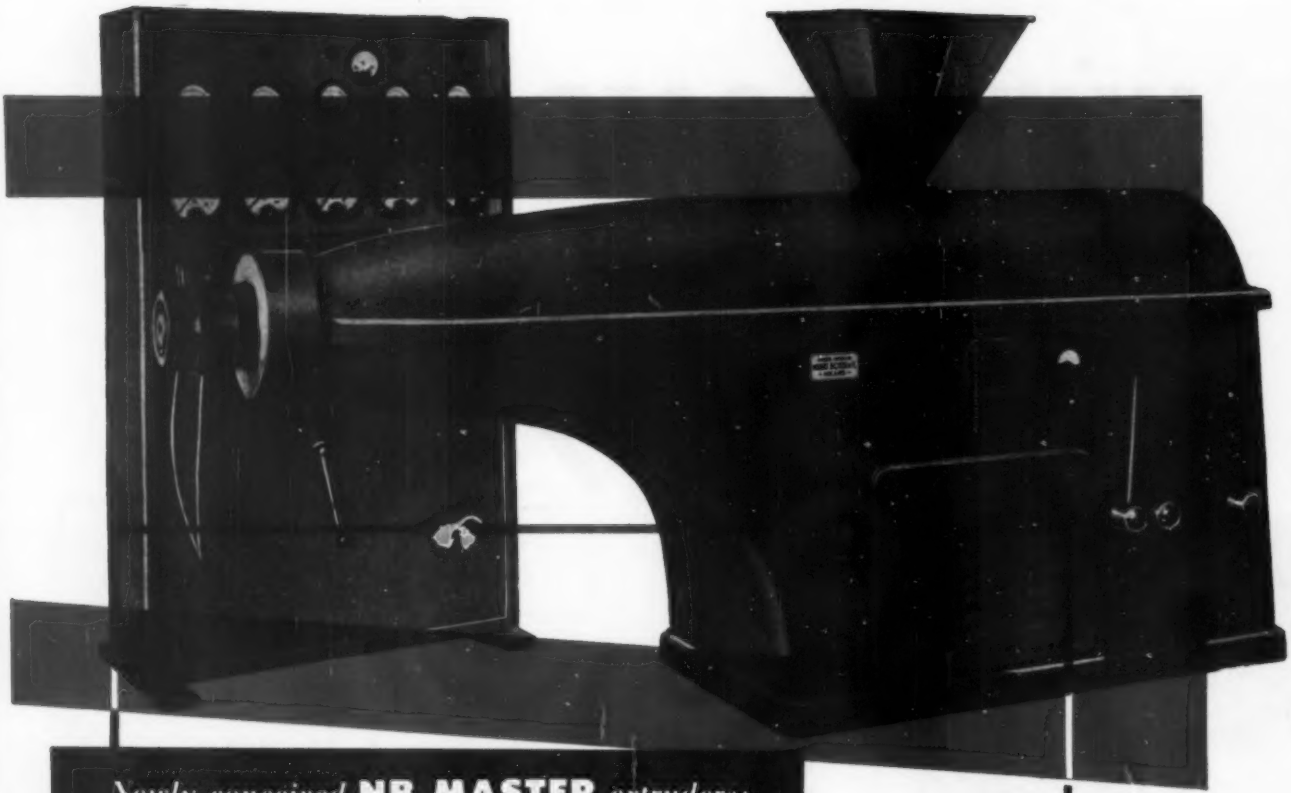

Newly-conceived **NB MASTER** *extruders:*

GREATLY INCREASED PRODUCTIVITY

- ▷ **built-in speed variator and screw revolution indicator**
- ▷ **separate heating zones ensuring constant control of proportional thermoregulation**
- ▷ **high efficiency designed long screws conceived for great productivity**
- ▷ **water cooled screws**
- ▷ **easiness in screw extraction for interchanging operation or cleaning of cylinder**
- ▷ **special designed rapid fastening method for quick assembling of heads**

model	*screw* ⌀
NB 30 MASTER	mm 30
NB 45 MASTER	mm 45
NB 60 MASTER	mm 60
NB 70 MASTER	mm 70
NB 90 MASTER	mm 90

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Negribos Milano

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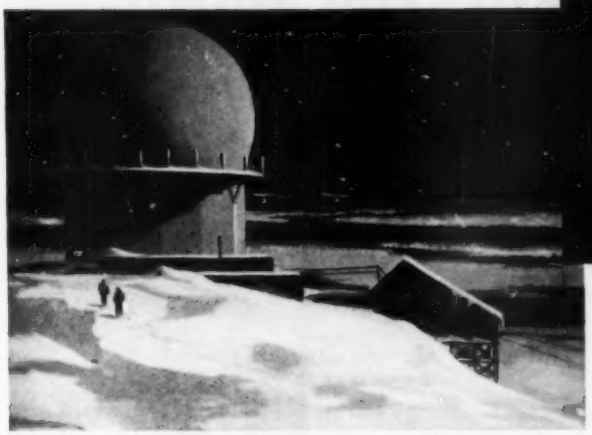
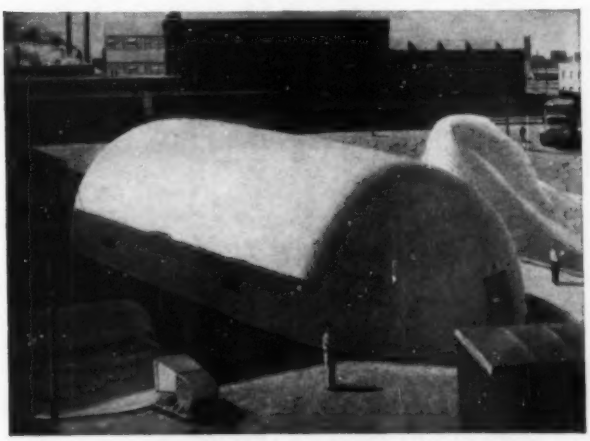


Vital radar equipment is housed in pressurized radomes of strong rubberized Wellington Sears fabric.

Structure is made by spraying concrete over balloon of rubberized nylon. Nylon base fabric supplied by Wellington Sears.



Welkote, nylon base fabric specifically engineered for vinyl and neoprene coating, is used in inflatable air structure.

A shelter for our continental military defenses, a concrete storage building, an air-supported warehouse—all built with fabric. They represent still another group of new developments in industry made possible by the use of fabric in working combination with plastic, rubber, and other materials.

In housing projects of this kind—and in new irrigation tubing, fuel tanks, belts, hose and other products made through the coating, laminating, combining or frictioning of fabric—Wellington Sears figures importantly. With this experience, and over a century of background in industrial textiles, supplying a wide range of base fabrics for many purposes, Wellington Sears can help solve *your* fabric problem. Call on us, and for informative booklet, "Fabrics Plus," write Dept. K-7.

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For Coated Materials, High and Low Pressure Laminates and Other Reinforced Products

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Plastics problem got you down?

Get help in a hurry from your Encyclopedia Issue!

EXAMPLE: ***Where and how to use resins and molding compounds?***

1. See the section "Resins and Molding Compounds" for all the fundamentals. Also see the materials charts and supplier lists in the "Technical Data" section.
2. Then check the Advertisers' Index—on the first page of the "Resins . . ." section—for suppliers' ads on resins, coatings, emulsions, etc.
3. Secure additional names and addresses of suppliers from extensive Buyers' Directory lists in the back of the book.
4. Consult the Alphabetic Index for detailed cross-referenced listings of subjects related to your particular inquiry.
5. For more data, mail us the post cards in the enclosed Encyclopedia "How-to-use-it" Guide.

EXAMPLE: ***How to color plastics?***

1. See the section "Chemicals for Plastics" for complete background.
2. Next, refer to the Advertisers' Index on the first page of the section for ads relating to your specific needs.
3. Check the Buyers' Directory for a detailed listing of suppliers of dyes, stabilizers, plasticizers, etc.
4. Consult the Alphabetic Index for detailed cross-referenced listings of subjects related to your particular inquiry.
5. For further information, send us the post cards in the enclosed "How-to-use-it" Guide.

EXAMPLE: ***How to design a product—then get it made?***

1. Get the basic facts in the section "Engineering and Methods".
2. Then for molder and special service advertisements, see the Advertisers' Index on the section's first page.
3. Next, examine the Buyers' Directory for additional names and addresses of molders, extruders and service organizations.
4. Consult the Alphabetic Index for detailed cross-referenced listings of subjects related to your particular inquiry.
5. Send us the post cards in the enclosed "How-to-use-it" Guide for further information.

EXAMPLE: ***Which machinery to buy?***

1. Turn to the section "Machinery and Equipment" for a complete picture of the factors involved.
2. Then see the Advertisers' Index on the first page of this section and select ads whose messages bear on your problem.
3. Get further information—names and addresses of machinery, machine tool and equipment manufacturers—in the time-saving Buyers' Directory.
4. Consult the Alphabetic Index for detailed cross-referenced listings of subjects related to your particular inquiry.
5. Write for more information using the conveniently enclosed post cards in the "How-to-use-it" Guide.

The Encyclopedia is expressly designed to help you solve your problems. Reach for it next time you need help and see how valuable it can really be!

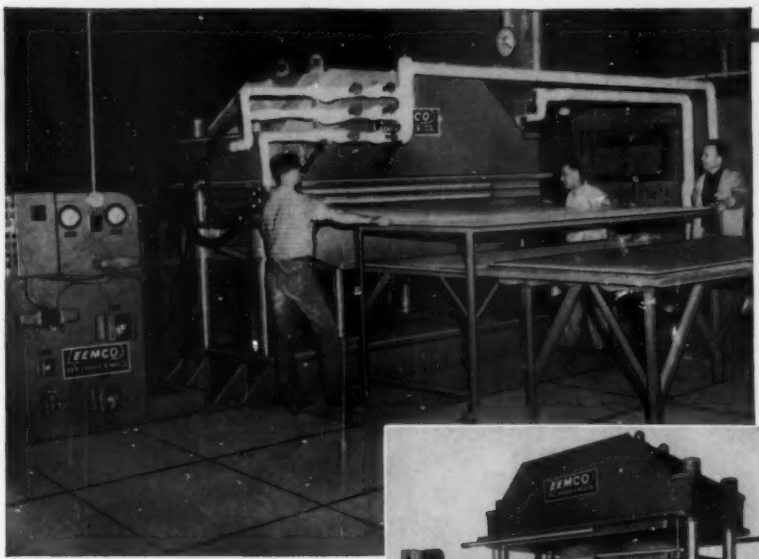
MODERN PLASTICS ENCYCLOPEDIA ISSUE

. . . for fast, accurate answers to plastics problems

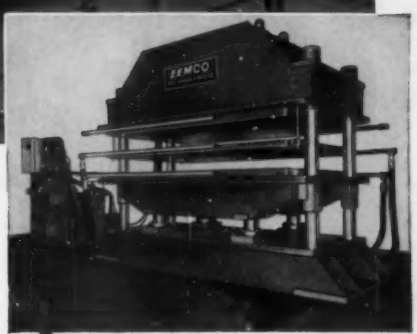
Alsynite COMPANY OF AMERICA selects

ERIE ENGINE & MFG. CO. PRESSES

to make fiberglass shatterproof window panes!



Especially designed and custom built for Alsynite, this EEMCO press was recently installed in their Portsmouth, Ohio plant. More and better production has been achieved. Automatic features have eliminated costly mistakes and greatly reduced time loss and rejects. Just as Alsynite has developed a completely new approach to industrial daylighting with their scientifically designed shatterproof window panes, so has EEMCO shown the way to increased and stabilized production and enabled them to give their customers a higher quality and more uniform product



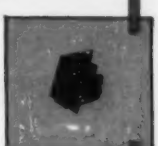
INVESTIGATE EEMCO FOR YOUR RUBBER AND PLASTICS PROCESSING NEEDS AND PROBLEMS

The competent engineering staff and experienced workmen of EEMCO are ready to help with any production problem you may have—before you buy, investigate EEMCO delivery, specifications and prices. EEMCO designs and builds a complete line of mills and hydraulic presses for the rubber, plastics, wood products, and fiberglass industries.

Pictured above is the 102" x 60" EEMCO 110 ton hydraulic press built for Alsynite—complete with automatic cycle controls and pressure regulators. Other EEMCO installations have achieved similar successes and helped owners toward the goal of more and better production. Why not investigate EEMCO for your hydraulic press requirements?

REINFORCED FIBERGLASS MOLDING PRESSES

DOWN OR UP ACTING PRESSES *(OPTIONAL)*



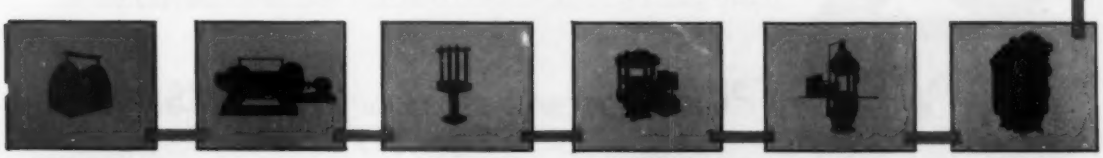
FIBERGLASS PREFORMER *(ALL SIZES)*

CURING OVENS *(ALL SIZES)*

EEMCO ERIE ENGINE & MFG. CO.

954 East 12th St., ERIE, PA.

Designers and builders of a complete line of mills and hydraulic presses



LABORATORY MILLS | MILLS | LABORATORY PRESSES | COMPRESSION MOLDING PRESSES | TRANSFER MOLDING PRESSES | LAMINATING PRESSES

Periodic Chart of the Atoms, Copyright W. M. Welch Mfg. Company, Chicago

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There's a hidden ingredient in every Argus product. It's the basic, bred-in-the-bone curiosity about your problems that enables Argus research to keep turning out better and better vinyl plasticizers and stabilizers at lower and lower cost.

Many of Argus' superior products have been developed, or improved, in the course of finding answers to specific technical problems posed by customers. The reason: every member of the Argus research staff is a recognized authority in the vinyl field.

If you want the *right* answers, ask Argus. We'll find them for you in our regular line of Mark stabilizers and Drapex plasticizers — or in basic, original research done on your product by our Technical Service Staff. Write for technical bulletins and samples.

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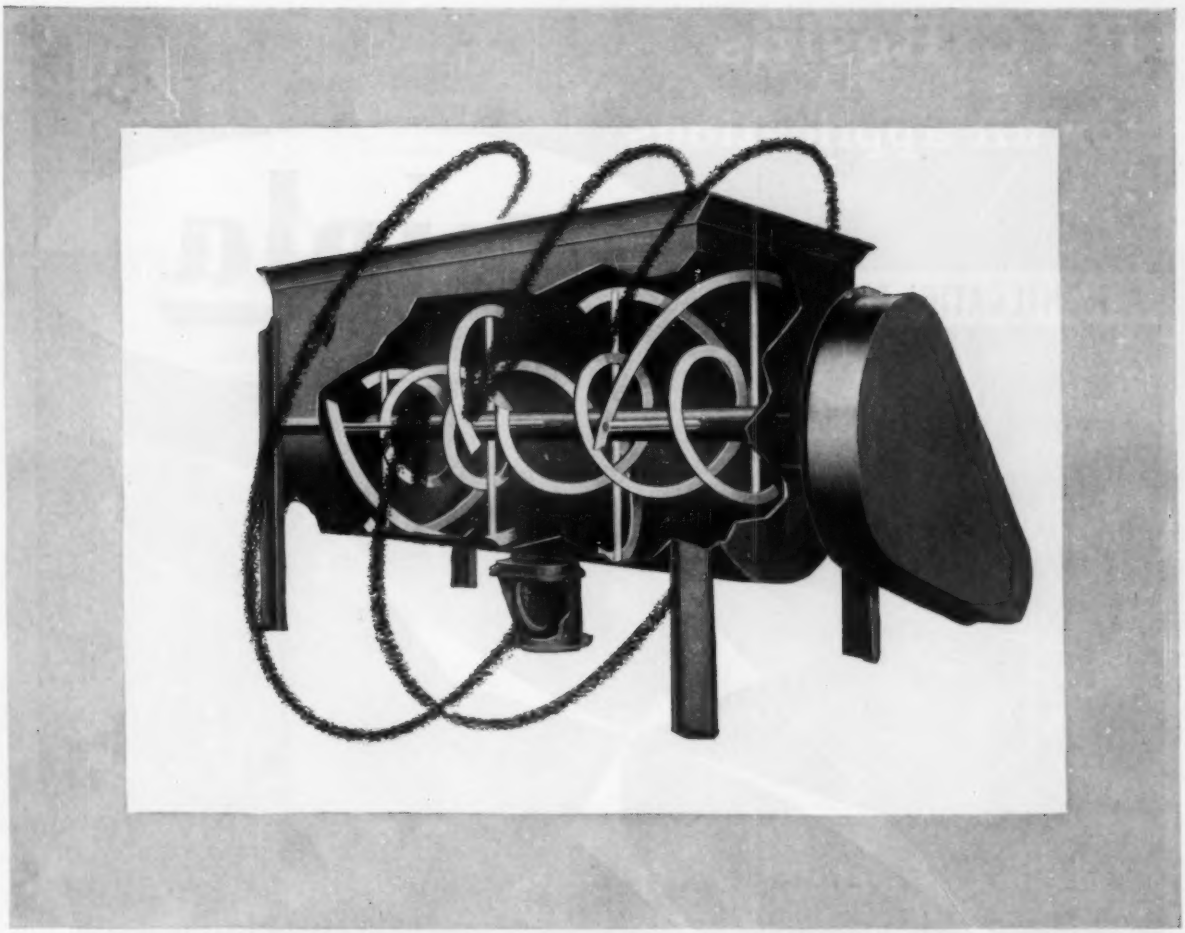

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Counterflow action of ribbon agitators accounts for thorough, high-speed blending, assures equal mixing throughout the entire volume.

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Heavy-duty construction of carbon or stainless steel permits efficient service under long runs and rugged operating conditions. Working capacities range from 1 to 650 cubic feet.

For more information see Chemical Engineering Catalog pages 1483 to 1490 . . . or write direct.

READCO

Whatever the mixing job: a READCO mixer!

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York, Pennsylvania
A Division of
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PVC Resins

for all applications

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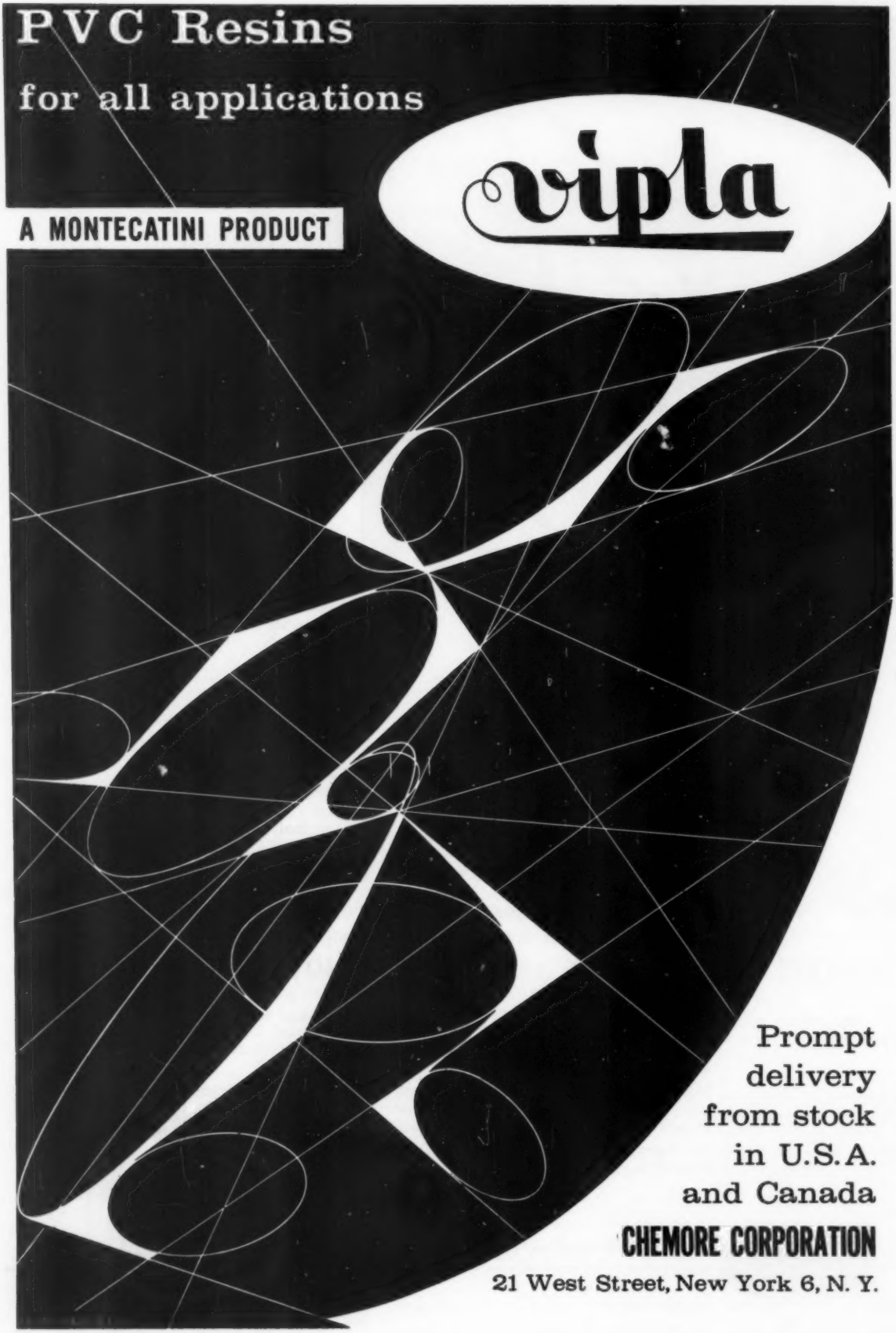

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names that mean

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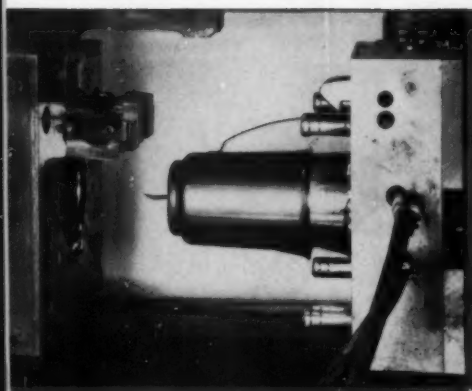

DIE STEELS

for
plastic molds
and die casting dies

MC The Mold and Cavity die steel made with particular care to permit blemish-free, highly finished surfaces. Furnished heat treated to 300 Brinell or annealed. Very deep hardening—uniform throughout large sections. Very low movement when oil quenched. For lower finishing costs and longer die life, use MC!

Speed-Cut Free-machining at 300 Brinell. Choose Speed-Cut for economy in producing backing plates, cavity plates, spacer blocks and other plastic die parts. And when you must avoid *all* movement, machine Speed-Cut after hardening—with ease!

Hotform The original 5% chromium, most widely-used die casting die steel. Will withstand extremes of service conditions—tough, strong, highly resistant to thermal shock.

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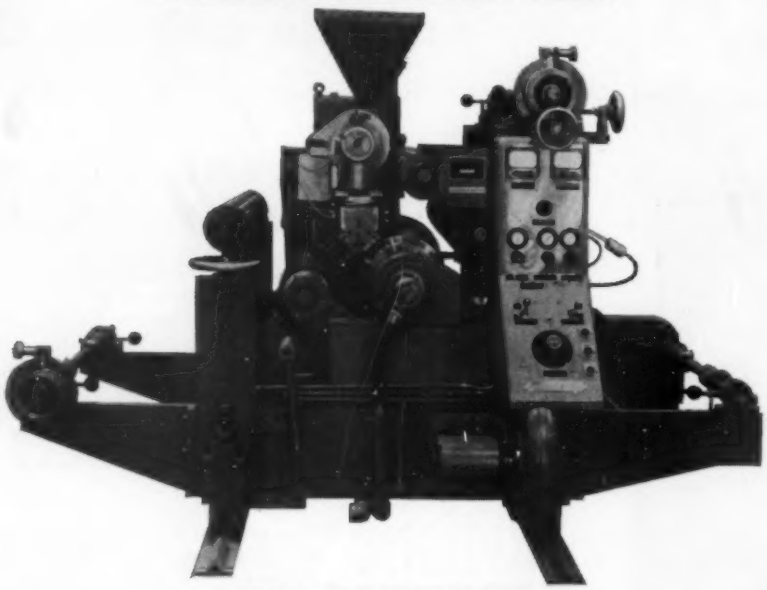
Egan

POLYETHYLENE EXTRUDER-LAMINATORS FOR LABORATORY OR PILOT PLANT.



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NEOPRENE PRESSURE ROLL WITH WATER BATH
PATENTED LAMINATING NIP ADJUSTMENT
2½" ELECTRICALLY HEATED EXTRUDER
SILICONE ROLL (OPTIONAL)
MASTER CONTROL PANEL
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SLITTERS & TRIM DISPOSAL SYSTEM
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VARIABLE SPEED DRIVE
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SPECIAL COOLING ROLL WITH RECIRCULATING PUMP
24" WEB WIDTH—UNIT SHOWN

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SOMERVILLE, NEW JERSEY

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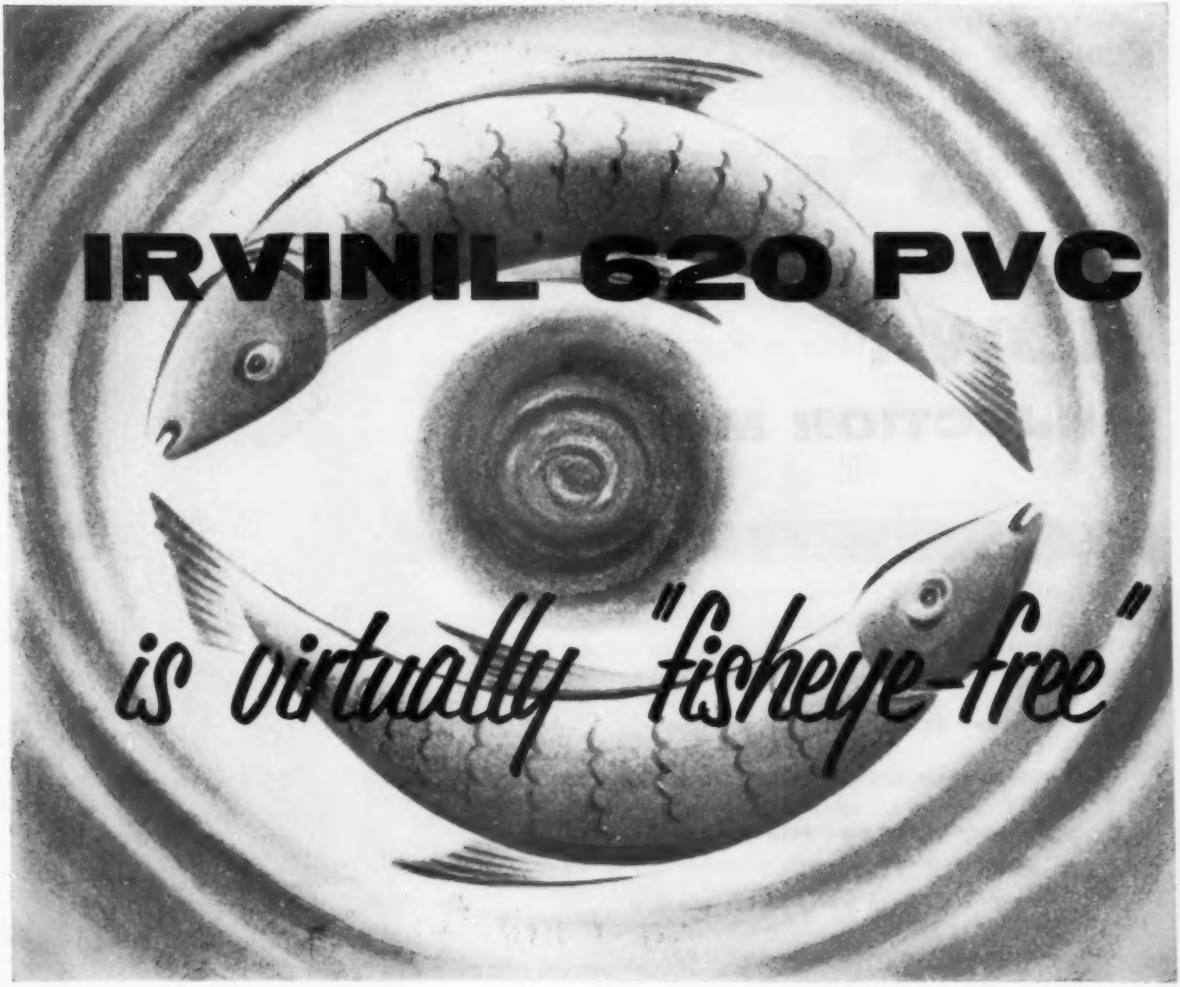

"fisheyes" in finished products can be caused by any one (or combination) of several factors. Dirt, fibers, cross-contamination with another resin, or gelling of the actual resin itself. That's why the sensible way to combat this problem is, first of all, to select a superior PVC resin. A resin—in this case—such as Irvinil 620, a medium molecular weight polymer specially designed for calendering operations.

Irvinil 620's superiority comes from the extreme care taken in its manufacture. Continuous close inspection, as a case in point, directly *eliminates* the fisheye causatives—coarse particles and horny polymer. As a result, a free-flowing powder is produced which gives you *uniform* porosity and *high* plasticizer absorption.

And Irvinil 620 gives you these other sought-after processing and product advantages, as well: strength, versatility of application, rapid dry blending properties, exceptional heat and light stability, high bulk density, very good color retention and fine electrical properties. A final point: even with all these advantages, Irvinil 620 costs you no more!

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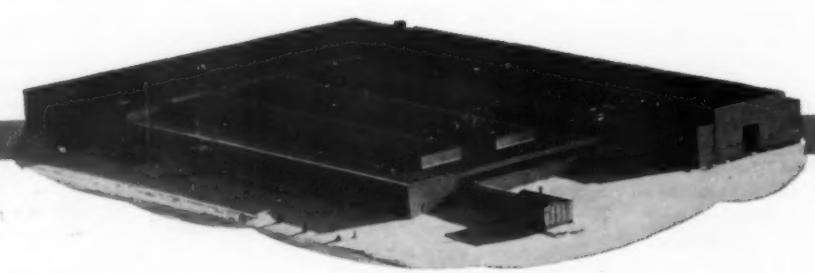

MINNESOTA PLASTICS CORPORATION

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Don't miss . . . in this issue

First report on plastics in Russia. Dr. Herman F. Mark, world-famous polymer chemist, recently lectured in the U.S.S.R. and made a study of Soviet research in polymer chemistry. Is Soviet polymer science more advanced than ours? What kind of facilities do their scientists have? What is the relationship between developmental science and application in industry? On what phases of polymer science are they concentrating? The answers will be found in "Soviet polymer science today," p. 111.

Epoxy-coating cuts camera costs. Interiors of molded phenolic cameras used to be sand blasted and flat lacquered to eliminate glare. Now a dull epoxy finish is applied to the shiny phenolic surfaces, doing the job at a much lower cost. For the story of this efficient finish, read "Epoxy coating improves cameras," p. 89.

Developing trends in plastics housewares. Our lead article, which, with our cover, reflects the importance of the Housewares Show, deals with outstanding recent developments in the design, production, and distribution of plastics housewares. New materials and combinations of materials, new styling, new methods of applying decoration are involved. Coming up are bigger moldings than have been seen to date, higher heat resistance, greater utility in these products. See "Housewares," p. 75.

Thermoset materials for automatic molding. There is a vast difference between material requirements for manned molding presses and for automatic presses. Uniform and uninterrupted powder feed, good pre-heating properties, rapid flow, fast cure, easy mold release, and rigid set on ejection are the chief requirements in automated plants. How to select proper thermosets for this type of production is described in "Properties required of thermosets for automatic molding," p. 104.

Vinyl wall for the U. S. Pavilion in Brussels. Laminated transparent rigid vinyl forms the precedent-shattering wall of this magnificent structure. Why and how this material was used are explained in "Transparent vinyl wall," p. 88.

Where polyethylene replaces water. Because this plastic, when bombarded with neutrons, becomes thermoset it makes a fine quenching core for a small nuclear reactor, slowing down the neutrons and absorbing their energy. In this use, polyethylene replaces water. It is safer and more efficient because it contains more hydrogen than water and because it will not boil off. See "The moderator is polyethylene," p. 90.

A new method of molding dry-colored polyethylene. Through examination of thin molded disks by transmitted light, a new breaker-plate design, in which the holes are venturi-shaped orifices, has been found quite as effective in achieving good color distribution in molding as can be obtained by extrusion compounding. This development can mean great cost savings to molders of colored polyethylene. See "Molding dry-colored polyethylene," p. 97.

The markets for polyethylene pipe. How much polyethylene is going into pipe today? Where is the pipe being used? What sizes and types are proving most popular? What markets are likely to expand most in the next few years? What are the problems in this field? These questions are answered in the first of a series of articles on plastics pipe, "Markets for polyethylene pipe," p. 82.

Permanent, vandal-proof, maintenance-free murals. Good news for institutional decorators: new techniques make possible works of art through the medium of decorative laminates, promise to solve costly replacement problems. Areas of application include lobbies, dining halls, public rooms, offices, schools, stations, and others. For a run-down on where this art is being successfully used, how it is made, and what it costs, see " 'Laminate art'—new mural medium," p. 92.

Complex phenolic moldings in a dictating machine. Two new Dictaphone devices use unusual transfer molded phenolic parts for economy and efficiency. Nylon, styrene, and butyrate are also involved. See "Phenolic for complex detail," p. 80.

Watch for . . . our August lead feature on the economics of automatic thermoset molding . . . a complete coverage in August of new developments in plastics applications in the shoe field . . . the second article in our series on pipe, this one to cover reinforced plastics pipe . . . a review of some unusual extrusion applications . . . a story on plastisol-coated metal sheets and their uses . . . a series of case histories on "Make or Buy" decisions by end user industries . . . and more detailed stories to show you how to make more profits with plastics!

MODERN PLASTICS

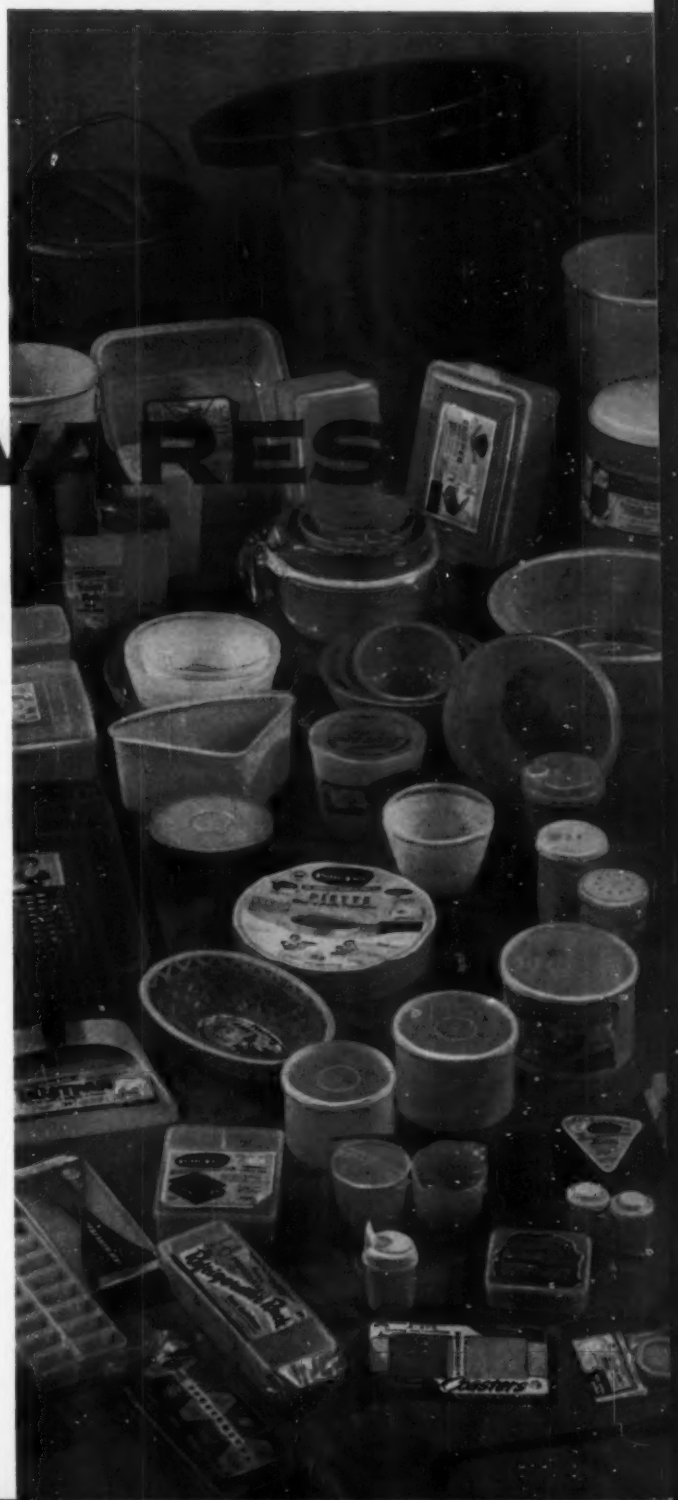
How new ideas, new designs, and new materials are increasing plastics' stake in

HOUSEWARES

With approximately a million new U. S. family units being created annually, and with the number of U. S. households expected to reach 53,600,000 by 1962, the housewares market looms large as a continuing major outlet for plastics.

Housewares—plastics and otherwise—are big business. According to the National Housewares Manufacturers Association, total retail sales of housewares now run approximately $3 billion annually. The percentage of housewares made wholly or largely of plastics has been increasing rapidly in recent years and should continue to climb from the present estimated consumption of 150 million lb. of plastics annually.

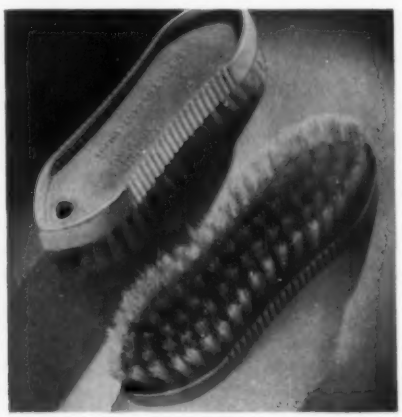
New product ideas are the lifeblood of the plastics housewares industry. With rare exceptions, a completely new type of item making its appearance at one of the housewares shows is



Molded polyethylene housewares range from baby food jar covers to bulky garbage pails and trash cans. How plastics compete with other materials in housewares field is outlined in box on p. 77. (Photo, Du Pont)

Two-compartment bucket does double household duty. Molded of polyethylene by Federal Tool Corp., Chicago, Ill., the pail has twin 7-qt. sections, one for washing, the other for clear rinse water. (Photo, Monsanto Chemical Co.)

Colorful container, made of high-density polyethylene, smartly styled, light in weight, virtually unbreakable, and boilproof, is designed for dripless dispensing of syrups, cream, and salad dressings. Blow molded by Royal Mfg. Co., Prescott, Ariz. (Photo, Hercules)



Resistant to swelling and warping, new all-plastics scrub brush combines block molded of styrene acrylonitrile material with bristles of styrene monofilament. Bristles resist rotting, mold, and mildew that destroy conventional brushes. (Photo, Bakelite Co.)

soon followed by basically similar products from other producers. Competition is extremely keen and it is difficult for a manufacturer to maintain the advantage of an exclusive item for long. Basic design ideas for new housewares are often sparked by the suppliers of plastics molding materials.

Many materials used

The phenolics dominate the field for cookware handles, toaster bases, ash trays, and other high-heat applications; melamine is the leading material for dinnerware. For colorful mixing bowls, wastebaskets, food storage containers, pitchers, and the dozens of other products which now lighten kitchen chores, thermoplastics hold sway. Several newer materials, however, are making a strong bid for a larger share of this important market.

Plastics dinnerware represents approximately a $70 million annual market at the retail level. During the past couple of years, merchandising of melamine tableware has been stepped up through the introduction of colorful patterns. Now coming into this market are some of the newer thermoplastics, such as styrene-acrylonitrile copolymers and methylstyrene, which may capture a sizable slice of the dinnerware business because of their resistance to heat and staining. They are produced by the relatively economical injection molding process, which makes them of added interest.

Polyethylene today stands as the dominant material volume-wise for molded plastics housewares. Steadily improved through the years, it shares the spotlight with several other thermoplastics, including styrene, styrene co-

polymers and alloys; and, for certain types of housewares items, various cellulosics.

Nylon, with greater toughness and higher heat resistance than other thermoplastics, enjoys limited use as a housewares material, but cost automatically excludes it from many applications. When specified in housewares, nylon is usually used to meet critical engineering problems, such as in gears and other functional parts for small appliances.

Two of the most important dark horses in the housewares material derby are high-density polyethylene and polypropylene. High-density polyethylene, now available from several suppliers, offers greater stiffness than conventional polyethylene, sufficient heat resistance to permit boiling of finished articles, better surface gloss, and improved resistance to scratching or scuffing.

Indications are that many molders of plastic housewares will turn to high-density polyethylene for applications where its special properties will justify its higher price. Says Louis H. Barnett, president, Loma Plastics, Inc., Ft. Worth, Texas, a leading producer of molded plastics housewares:

"In the housewares field today, high-density polyethylene has not been too prevalent, pri-

Boilable tumbler with fluted base is molded of methylstyrene by Tri-State Plastic Molding Co. (Photo, American Cyanamid Co.)

Temperature changes have no adverse effect on molded styrene alloy housing of ice-crushing attachment for home blender. Spout directs crushed ice into individual glasses. Molded of Dow 480 material by Victory Mfg. Co.

Economically speaking...

In today's belt-tightened industrial economy, the hard economic facts of life often determine whether a product gets the nod from wholesale buyers and retail consumers. The following summaries, from a buyer representing one of the nation's largest retail hardware organizations, spotlight some of the basic economies of typical housewares products made from molded plastics and competitive materials:

Laundry baskets. **When first introduced, polyethylene laundry baskets were somewhat more costly than traditional willow baskets. Now, they are about on a par with or even below the cost of good willow baskets, which they have largely replaced. The plastic clothes baskets have introduced new design concepts and colors matched to household decorating schemes. Soft and light, they cannot snag or tear clothes, require no liner, will last for years. They give the customer much more for her money.**

Dishpans. **A good quality rectangular porcelain enameled steel dishpan, retailing at about $1.40, is unyielding and heavy. It may chip sink enamel, break delicate dishes or glassware. Molded polyethylene dishpans, available at competitive or lower costs, offer integral color, light weight, and "built in" protection for dishes, glassware, and sink. Such features of the plastic dishpan have virtually driven the metal type off the market.**

Water buckets. **For many years, the common 10-qt. water pail was made of galvanized sheet steel. Early polyethylene pails, retailing at around $2, were far above it in cost. Today, polyethylene buckets with pouring lips and other functional features not found in metal buckets sell for approximately half this amount. Though their metal counterparts may retail as low as 59 or 69¢, the polyethylene pails sell readily because of such advantages as lighter weight, wide color range, non-denting characteristics, and the fact that they can do double duty as ice buckets, picnic carry-alls, etc. Style, plus added utility, has sparked the ascendancy of the plastic bucket over the old metal pail.**

Wastebaskets. **Although wastebaskets of lithographed metal, decorated fibreboard, and other materials may be lower in cost than molded plastics baskets, the latter have grown into a highly successful housewares item because of molded-in colors, light weight, and non-denting properties. They are preferred in the home because they are completely waterproof, cannot rust and mark the floor, and cannot scratch or damage walls or furniture. They readily fill many roles in addition to their primary use as waste receptacles.**

marily because we have spent so many years building up 'soft squeeze-bottle' polyethylene in our customers' minds . . . However, I believe a gradual transition will take place, particularly in sterilizable items or items where impact or freezing properties may be of importance. Gradually, as the price of high-density material comes down, more and more of it will be seen in the plastics housewares field," Mr. Barnett explains.

With polypropylene, the future is much more speculative because of limited experience with the material in this country. However, as pointed out recently ("What's with polypropylene?" MODERN PLASTICS, 35, 89, Mar. 1958), this new material has a host of properties which could make it a strong contender in molded housewares—toughness, a wide range of colorability, very light weight, higher tensile strengths and rigidity than high-density polyethylene, and heat resistance in the 300°-plus range.

Styrene-acrylonitrile copolymers and methylstyrene, already mentioned as contenders in the dinnerware field, are also finding increasing use in baby feeding dishes and other types of

King-size, open-design utility hamper, molded of polyethylene, is an example of today's plastics housewares in the "big ticket" category. (Photo, Loma Plastics)

Expandable polystyrene, with unusual mottled decoration, is used to make ice bucket and coaster set by Automotive Rubber Co. of Detroit, Mich. (Photo, Koppers Co., Inc.)

Laundry baskets molded of tough yet soft polyethylene will not snag or stain clothes nor mar floors or walls. These lightweight baskets, with sturdy molded-in handles, are produced in turquoise, yellow, pink, and red. (Photo, Columbus Plastic Products, Inc.)

Paving the way to larger unit sales of related sets of housewares are such groups as this 12-piece informal dining set produced of methylstyrene by Leipzig and Lippe, Inc. (Photo, American Cyanamid Co.)

housewares. Both plastics are expected to figure even more prominently in the future plans of housewares molders.

Better design and colors

Design-wise, most of today's plastics housewares are a far cry from those available only a few years ago. A number of housewares manufacturers now enlist the talents of prominent industrial designers to style their plastics creations. For example, Reinecke & Associates, headed by Jean O. Reinecke, in recent years has designed numerous housewares items for Federal Tool Corp., Chicago, Ill. Entering the housewares field this year after years of experience with plastics as a leading toy manufacturer, Idealware, Inc., Hollis, N. Y., chose the well-known Russel Wright to design its distinctive line of "Refrigerator-to-Table" ware. Through the influence of these and other top-flight designers, the styling of plastics housewares continues to improve, always using the properties of the materials to best advantage.

Predictions of what colors will be popular with consumers six to 12 months in advance—when products currently on the drawing board are ready for the market—are being added to the services extended by Du Pont to designers and manufacturers of plastics products. The new service, made available through a recent agreement between the company's Polychemicals Dept. and Faber Birren, color consultant, is based on research into long-term trends. It will give the customer an integrated approach to design in which material selection and engineering are closely coordinated with trends in color and styling.

Along with improved design and closer attention to color treatment has come increased interest in surface decoration. Silk screening, hot stamping, die-cut filigree designs, and application of designs printed on plastic films, are among the methods employed to decorate molded housewares for added sales appeal. For its correlated group of bathroom wastebaskets and brush holders, Plastomatic Corp., Malvern, Pa., uses injection molded decorations which are permanently adhesive-sealed to the sidewalls. Molded to fit surface contours, the designs provide a rich three-dimensional decorative effect.

Loma Plastics recently introduced a new line of decorated polyethylene wastebaskets with surface decoration permanently embossed by hot stamping. "We feel very strongly that the trend will be toward decorated (*To page* 167)

Decorative effects highlight many new plastics applications in housewares. Matching hamper and wastebasket, molded of polyethylene by Beacon Plastics, have painted-on floral design. (Photo, Eastman Chemical Products, Inc.)

Utility and long service life of newly designed colander are assured by producing it of high-density polyethylene. Molded by Columbus Plastic Products. (Photo, W. R. Grace & Co.)

Housewares and freight rates

A complex battle over freight rates is currently in progress between molders of plastics housewares and the railroads and truckers. The outcome is most important to the plastics housewares industry, since about 8% of gross sales is spent on freight charges. For a detailed status report, see Section 2 of The Plastiscope, p. 194.

Microphone and cradle of President Dictaphone incorporates numerous molded plastics parts. Buttons in microphone housing control start-stop of recording machine, playback, and corrections

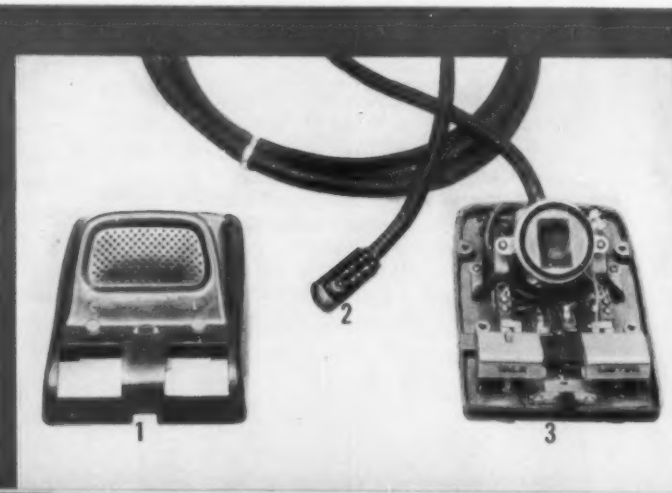
Subassemblies of President desksets. 1—inside and top views of cradle housing, with 13 molded-in inserts; 2—inside view of housing with electrical parts installed; 3—microphone; 4—base plate of cradle; P—phenolic preforms

PHENOLIC

Two new attractively styled dictation machines manufactured by Dictaphone Corp. make extensive use of complex molded plastics components. Most of the parts are phenolic, a low cost material which yields a combination of physical and electrical properties nothing else can offer. The machines, named President and Chairman respectively, are designed for use on the executive's desk and are connected to recording and playback instruments on the secretary's desk. The President has a small, streamlined hand microphone which rests on its own cradle when not in use; in the one-piece Chairman, the microphone is built in.

In both models, the housings are of transfer molded phenolic. They have a smart-looking

Housing of Chairman dictating machine, with built-in microphone, is molded of phenolic



View of instrument with top removed. 1—cover part of housing; 2—butyrate connector plug; 3—base plate with electrical parts and control buttons installed

Parts of dictating machine. 1—cradle housing; 2—assembled dictating machine; 3—inside view of cradle housing; 4—butyrate plug that connects microphone to recording instrument and has 11 molded-in inserts; 5—phenolic switch actuators that are attached to microphone housing; 6—microphone cap assembly; 7—two parts of microphone housing; 8—nylon latches that lock switch actuators in position; 9—acrylic jewels which carry light to show machine ready for use; 10—styrene parts for switch actuators and guide buttons; 11—nylon control buttons; 12—nylon playback buttons; 13—styrene pellets for part 10. Parts in inset slightly larger in scale

for complex detail

glossy appearance and offer excellent resistance to impact, perspiration, greases, and oils, to which such instruments may be normally subjected. These intricately-molded parts are produced in Dictaphone's own molding plant. The cradle for the President model, for instance, has 13 separate molded-in inserts.

In addition to the transfer molded phenolic parts, the new models also incorporate injection molded nylon buttons, styrene bearing housings, and butyrate plugs.

Credits: Phenolic molding material supplied by Durez Plastics Div., Hooker Chemical Corp.; nylon (for buttons), Du Pont; styrene (for bearing housings), Monsanto Chemical Co.; butyrate (for plugs), Eastman Chemical Co.

Parts of Chairman dictating machine. 1 through 4—major components of deskset; 5—urea switch actuators for "talk" and "listen" operations; 6—acrylic jewels; 7—nylon buttons; 8—"talk" and "listen" actuators; 9—nylon locking latches; 10—nylon levers for "listen" switch actuators; P—phenolic preforms; U—urea preforms. (Photos, Dictaphone Corp.)

Markets for polyethylene pipe

By James E. Sayre

Polyethylene pipe is continually seizing pieces of huge existing markets.[1] Its role to date has been as a specialty competing in fields which now annually consume 14 million tons of metal and 15 million tons of cement, clay, etc.

At present, polyethylene pipe consumes about 6% of all virgin material produced. During the past five years, the use of both virgin and scrap resin in pipe has grown from about 4 to 50 million lb. and is expected to top 85 million lb. by 1960. But such growth will be effected only if quality standards are enforced, if better resins are made available, and if the building construction industry realizes its expected revival.

Of nearly 100 extruders now operating, about 15 produce 90% of the polyethylene pipe made in the United States. The largest firms may use from 5 to 7 million lb. of resin per year. It is probable that there are only two or three such firms and a like number which may run as high as 4 million lb. per annum. The next dozen or so trail down to possibly 1 million lb. annually. The fact that this leaves only 10 million lb. of volume for some 75 producers points up a basic industry problem.

A new firm can always find some local volume and may be launched with a little know-how and a small investment. In addition, it is cheaper to ship resin than finished pipe and this also favors decentralized production. A comparison of freight costs shows that the cost of shipping pipe is generally from twice to several times the cost of transporting resin.

The existence of promising local markets

[1] See detailed surveys starting below.

Based on a paper presented by the author at the 132nd National Meeting of the American Chemical Society.

PRESENT AND FUTURE USES

FARM WATER LINES (1957: 8 million lb., 1960: 11 million lb.) America's 4.8 million farms present a huge potential for pipe. In addition to use in jet wells, low-pressure lines are often used from the pump house to the farmhouse, to distant pastures, barns, etc. Long continuous lengths of polyethylene pipe bring the water to the animals, and eliminate the need to drive animals to the water. It is not uncommon to find farms working with lengths of 3000 ft. weighing 600 lb. each. The De Motte-Evans Farm, Otwell, Ind., is reported to have installed over a million ft. of polyethylene pipe. In general, 1 in. pipe is used for farm water lines.

On the more than 37,000 animal farms for breeding dogs, rabbits, mink, etc., great labor savings are effected by providing each cage with its own water supply. One mink raiser, for example, installed 2500 ft. of 1-in. pipe. Problems in freezing weather, serious with metal pipe, are minimized; 2 p.s.i. is an average working pressure.

In the Swiss Alps, polyethylene pipe is widely used for conveying milk; one delivery line is 1½ miles long. In North Carolina, two miles of polyethylene pipe were laid by helicopters over mountainous terrain to deliver potable water.

Ingenuity constantly leads the way to new uses for polyethylene pipe. For example, it is said that metal lines subject to freezing and bursting may be protected by inserting a small polyethylene tube inside. If the line freezes it can be reactivated by circulating warm water through the polyethylene tube.

LAWN WATERING SYSTEMS (1957: 6 million lb., 1960: 14 million lb.) Private homes, golf courses, cemeteries, camps, parks, and resorts are using increasing amounts of polyethylene pipe. Possibly the greatest single potential, and just opening up, is for home lawn sprinkler systems. Many of our 35,000 retail hardware, plumbing supply, mail order, and farm supply outlets sell such kits. If such systems were installed in only 1% of the 40 million one-and two-family homes every year, 80 million ft. of pipe would be used, consuming about 20 million lb. of resin, based on an average of 200 ft. of 1- to 1½-in. pipe per home.

The pipe is easy to handle, flexible, and inert to various soil compositions. Systems are easily drained during cold weather, or if frozen while filled will expand without cracking. Fittings are freely available, inexpensive, and easily installed. The growth of such polyethylene pipe systems is expected to adversely affect the sale of another fine product—PVC hose.

The 5500 golf courses in the United States also offer a good potential; as strength of polyethylene pipe is improved to handle the pressure required for such in-

In competition with metals, cement, and clay, polyethylene pipe offers advantages of reduced labor cost, light weight, and corrosion resistance

Sayre

The author: President-elect of the Chemical Market Research Association, Mr. Sayre has been with Plastics and Coal Chemicals Div. (formerly Barrett Div.), Allied Chemical Corp. for 20 years, and is presently manager of marketing research and product development. For the past two years he has been a director of CMRA and will assume the office of president on July 1, 1959. A graduate of Rutgers University, he is a director of the New York Marketing Section—American Chemical Society, and is well known in the field of chemical economics.

and the fact that setting up production facilities requires comparatively little capital—a new extruder would cost about $23,000 and space requirements might run to something like 2000 sq. ft.—may tempt some producers to enter the polyethylene pipe field without a full comprehension of the real difficulties. Large capital is not too important because of the way a single extruding machine gobbles up resin. One machine operating about 4 hr./day can give a throughput of 200,000 lb./year, with gross sales of possibly $100,000.

Continued success, however, depends on product development, technical service, and quality controls; top grade pipe can be produced only as a result of long experience and laboratory study.

Severe problems arise when too many producers get into the business and when price cutting and dwindling profits result in poor quality pipe. Failures can be prevented only if the entire industry maintains standards—and polices them.

Extruders use many different channels of distribution at the present time which, under the pressure of a maturing product and heavy competition, will undoubtedly become more efficient. As shown in simplified terms in Table I, p. 85, the trade falls into three main strata: producers, wholesalers, and retailers. At least

Comparative costs of pipe are discussed under "Cost and handling advantages" in text on p. 84

stallations, demand will increase further. Many courses are already piped, but will occasionally need re-piping. One golf course has 16,000 ft. of pipe. If only half of our golf courses end up with such systems, it would mean a total potential of 44 million ft. of 1- to 2-in. pipe. The weight of the resin required would range from 0.2 to 1 lb./ft. of pipe, depending upon the gage and quality.

Increasing amounts of polyethylene pipe ranging from 1 to 3 in. in diameter are being used to keep grounds of cemeteries in good condition. In the U.S. there are 25,000 cemeteries having a combined area of 400,000 acres.

IRRIGATION AND SUB-IRRIGATION (1957: 3 million lb., 1960: 5 million lb.) Conventional irrigation service pipe pressures run up to 150 p.s.i., with occasional surges of 250 p.s.i. Polyethylene technologists are struggling to meet these demands but resins must improve, thicker walls must be utilized, and prices must recede, if polyethylene is to get much of this heavy-duty business. Polyethylene has much to offer in long lengths, but there is severe competition from aluminum, and prices for the two materials in large pipe sizes are substantially the same.

Sub-irrigation: To minimize evaporation, water is sometimes dispersed underground via perforated polyethylene pipe. Pipes may be wrapped in glass cloth to disperse water more uniformly and to minimize clogging of pipe perforations.

Such systems of perforated pipe may also be used to distribute liquid nutriment. Perforated pipe is used to an increasing degree in greenhouses where water and liquid fertilizer are both applied through the conduit. Approximately 17,000 greenhouses in the United States, covering some 5000 acres, offer a sizable market for pipe from ½ to 1½ in. in diameter.

In reverse, the perforated pipe system is being used for drainage. Prices are reported to be competitive with tile in diameters up to 3 inches. In order to prevent tube deformation greater than 20% of the original diameter, wall thicknesses for 1½- 2-, and 3-in. pipe have to be 0.04, 0.05, and 0.08 in. respectively. Deformation problems are said to make 4-in. polyethylene pipe too expensive to compete economically because of the thick wall required.

JET WELL LINES (1957: about 7 million lb., 1960: 15 million lb.) Copper, aluminum, or steel have been the traditional materials for jet well lines; installations often required derricks, heavy couplings, and the labor of two men for an entire day. Pipe weight would

14 distinct types of wholesalers handle the product.

Plastics pipes have now been accepted and included in state codes in California and Wisconsin. In Wisconsin, the state plumbing code was recently amended to permit their use in "underground pressure piping for potable cold water systems serving private residences and farm buildings" outside incorporated areas. The California public utilities have approved the use of plastics pipe in privately owned facilities. Limited approvals have also been given by several cities for various types of plastics pipe.

The National Sanitation Foundation has approved a number of formulations of virgin material as suitable for pipe to be used in transporting drinking water.

Standards

The third of three sets of standards for plastics pipe was established in April 15, 1957, by the U. S. Department of Commerce. It covers performance, and material for standard wall, 75, and 100 p.s.i. polyethylene pipe. Standards on types of plastics pipe are being processed by the American Standards Association, the A.S.T.M., and S.P.I. to establish them as engineering and industry materials. A continuing study at the Batelle Memorial Institute, Columbus, Ohio, has as its prime objective the creation of short-term testing methods which can accurately predict long-term service of plastics pipe under given conditions.

Working through plastics industry committees, an effort is being made to get approval from FHA for various types of lawn sprinkler systems. Local level approval of some types of products has already been granted.

Cost and handling advantages

The greatest advantages of polyethylene pipe are its light weight, flexibility, and continuous length which lead to tremendous savings in installation costs. It can, for example, be laid underground at a rapid rate by mole-plow. Its price is definitely trending downward, whereas metal is moving upward.

It is difficult to formulate a simple meaningful cost comparison, partly because of heavy freight charges on metal pipe. In comparing 1-in. standard pipe, it is estimated that the jobber pays (after discounts) about $13 per 100 ft. for polyethylene, at least 10% more for butt welded black iron, and about 25% more for galvanized; copper tubing would be two to

PRESENT AND

often run as high as 540 lb. per 100 feet. Now one man can do the same job in half a day with 80 lb. of polyethylene pipe for the two 100-ft. lines; 1- and 1¼-in. pipe are generally used.

More than 700,000 wells are put down each year. Approximately 200,000 are deep wells and some 300,000 are shallow wells; about 85% of both groups are jets. Also, about 175,000 are convertible jets and the remaining 50,000 are submersibles—a class that is usually a little too rugged for polyethylene since the pump is suspended at the bottom end of the pipe. The weight of the pump stretches the pipe; torque tends to weaken it. These are problems which may be solved later by mechanical means.

The use of polyethylene pipe in only half of the jet wells in the first two classifications would mean an annual demand for 35 million ft. of pipe using about 9 million lb. of resin. Other wells should account for another 3 million pounds. As water tables recede and home building increases, these potentials will increase.

HOUSEHOLD PIPING (1957: 8 million lb., 1960: 12 million lb.) The household market consumes about 70% of all standard metal pipe. Approximately 1 million homes are presently being built per year and an increase to 2 million units per year is expected by 1975. Many of the existing 50 million homes are being remodeled, and it is estimated that approximately 2 million homes are re-piped annually because of metal pipe failures. In rural and resort areas, particularly, polyethylene is being used extensively today; it is making headway here because it is less expensive, failures are not so costly, and because less complex communities have more liberal codes. Where low pressures are adequate, and where temperature requirements are not acute, low installation costs offer large savings.

In this connection it should be noted that commercial standard polyethylene pipe 1 in. in diameter is generally rated at about 80 p.s.i. at 73.4° F. At the same temperature, ½-in. pipe would carry a rating of about 100 p.s.i., as compared to approximately 42 p.s.i. for 4-in. pipe. Of course, premium-priced polyethylene pipe is available, rated at 100 p.s.i. for all sizes from ½ to 2 in. in diameter, and improved polymers are just coming on the market for pipe with a rating of 120 p.s.i. for 1-in. diameter.

One of the main targets for plastics pipe which may fall to polyethylene is 4-in. sewer pipe to replace cast iron inside the home. This non-pressure waste disposal line is now made up of many heavy, brittle, lengths of pipe and is expensive to install. Since each

three times as much, and red brass several times as much.

Polyethylene also has many fine advantages in resistance to strong acids, galvanic effects, alkalies, sulfates, bleaches, and salt and caustic solutions. It does not rot and does not react with soils, nor does it encourage the accumulation of foreign matter which impedes flow. Another advantage is that polyethylene does not conduct electricity.

With regard to aging, accelerated exposure tests led Bell Laboratories five years ago to predict a life of "at least 20 years."

Limitations

As can be seen from Table II, p. 86, and from the detailed discussions of end uses in this article, polyethylene pipe at its present stage of development already has a large market and a fast-growing potential.

But additional volume applications still remain to be conquered, and it is not unlikely that intensive research will soon overcome some of the limitations which still exist. For example, polyethylene pipe is deficient in its resistance to solvents, particularly chlorinated solvents and aromatic hydrocarbons such as are found in some gasolines. It is not suitable

Table I: Channels of distribution, in approximate order of volume handled

Producers	*Wholesalers* (*discounts 25, 20, 10, 5%*)	*Retailers* (*discounts 25, 10%*)
Independents	Independents	Independents
National metal pipe producers	Farm co-ops	General
National Plumbing & heating goods producers	Farm supply	Farm supply
Mail order	Metal pipe	
	Building materials	Metal pipe
	Plumbing & heating	Building materials
	Pipe & supply	Plumbing & heating
	Hardware	Hardware
	Industrial & mill supply	Mail order
	Well & pump contractors	Industrial accounts
	Mine supply	Well & pump contractors
	Heating & air conditioning	Swimming pool contractors
	Greenhouse suppliers	
	Mail order	

FUTURE USES (*continued*)

home uses about 75 ft. of such pipe, this application offers the large potential of 100 lb. of resin per installation. Somewhat better temperature tolerances would be helpful, since householders may run hot water for protracted periods.

Cold water distribution lines: Polyethylene replacement for brass, copper, and black iron may run into considerable volume where codes are not strict. Such systems should now include a check valve for preventing hot water from backing up into the system, but irradiation, new polymers, or other improvements may eliminate the necessity for these valves. A home using 30 ft. of 1-in. and 80 ft. of ½-in. polyethylene pipe would represent a consumption of 17 lb. of resin.

Water service connection lines: Polyethylene water lead-in lines are being used extensively to replace lead and black iron in rural and resort areas. Fifty feet of 1-in. lead-in would consume from 9 to 14 lb. of resin per installation, depending upon wall thickness.

Street connection gas lines: Some polyethylene is being used now in rural areas where codes do not offer too many related complex problems. Usage must be confined to natural gas areas, because hydrocarbons in manufactured gas can disintegrate most polyethylene pipe. Metal pipe is now being used, but potential for polyethylene runs into thousands of miles per year.

Radiant heating: Permanent installations of polyethylene pipe are finding increased use in radiant heating systems, replacing copper tubing. The pipe is buried in concrete and heated water is circulated through it. Considerable care has to be exercised to make sure that technical problems are adequately recognized in such installations; some extruders do not consider polyethylene as yet well suited to this use. Pipe diameter is usually ¾ inch.

Air conditioning: Water-cooled air conditioning is expected to use increasing amounts of polyethylene pipe. Where the demands of hydrostatic heads are not too severe, the pipe is used to connect the cooling tower to the unit, two lines being required. Small-bore tubing is also used in condensate drains.

MUNICIPAL WATER SUPPLY. The cost advantages of polyethylene pipe over copper tubing have aroused the interest of municipal water companies. The principal uses are as water service lines connecting the main to the curb stop, and as lines connecting the curb stop to the home. Pipe from ½ to 6 in. in diameter is used. In a few cases, polyethylene pipe has been employed for the entire water system, but usage is still considered experimental. Since the cost of replacing failures is exorbitant, especially under paved streets,

Table II: Estimated virgin and scrap polyethylene resin consumption for pipes by end use

End use	*1957*	*1960*
	million lb.	*million lb.*
Farm water lines	8	11
Lawn watering systems	6	14
Irrigation and sub irrigation	3	5
Jet well lines	7	15
Household piping	8	12
Corrosion and petroleum piping	3	6
Swimming pools and skating rinks	3	6
Mine usage	2	2
Tubing and casings	5	7
Other uses[a]	5	7
Total all resins	50	85

[a]For air conditioning, radiant heating, municipal water systems, conduit, ducts; also for other miscellaneous uses not described in the text.

for fuel oils, alcohols and glycols, esters, and ketones, or for animal and vegetable oils.

In competition with metal pipe, of course, its working pressures and temperature resistance are poor. Another limitation in building applications is that nails can be driven through polyethylene, but this is also true of copper.

A survey of 40 extruders and jobbers brought out the following weaknesses: 24 stated that temperature ranges should be raised; 21 said that pressures should be improved; 14 were worried about stress and fatigue cracking and slitting; eight complained about fittings. Several requested lower cost resins. "More flexible pipe," "less flexible pipe," "easily damaged," and "possible puncture by nailing" were other comments made.

National housing codes and fire underwriters prohibit use of polyethylene pipe in many applications. Local health authorities are unfamiliar with its advantages. Mechanics stick to more expensive metal pipe to increase their dollar sales and labor charges, and consumers are not aware of the savings that can be effected by using polyethylene pipe. Constant education is necessary to overcome such barriers to expanding use.

New frontiers

Only during recent months has low-pressure-processed high-density material started to exert an impact upon the market. Accordingly, this study deals mainly with low-density polyethylene.

Some of these new high-density materials,

PRESENT AND

water companies must be convinced that polyethylene pipe will meet their stringent requirements.

CORROSION AND PETROLEUM PRODUCT PIPING (1957: 3 million lb., 1960: 6 million lb.) Jobbers specializing in corrosion piping have now added polyethylene to their lines. It is being used in the textile, paper, and chemical industries to convey acids, coatings, and many troublesome chemicals. It is also ideally suited for many waste systems containing corrosive elements.

Examples: Polyethylene pipe has been widely used in battery plants for conveying acids. Potash firms have utilized miles of pipe as liners in existing corroded metal lines. A paint pigment manufacturer installed polyethylene pipe to dispose of waste material containing 60% sulfuric acid. A cotton mill uses it for continuous service in unloading tank cars containing caustic soda. In a leather tannery, it is used to move corrosive chemicals at low temperatures, as well as for transporting cold water to process equipment. A vinegar producer is said to be a large user.

Because polyethylene has poor tensile and low beam strength, line suspension problems arise, which may limit its use. At times, old metal lines are employed for support. Users cannot always risk breaks in lines carrying dangerous liquids, and, of course, polyethylene does not always meet pressure and temperature requirements. In corrosion piping, money is often no object and users turn to stainless steel, lead, glass, and other materials.

Petroleum piping: Considerable polyethylene is used in petroleum fields for piping brine and sour crudes containing hydrogen sulfide, for lead-in lines, flow lines, well tubings, and casings. Although most polyethylene pipe will swell when used for certain petroleum crudes, this limiting factor may be overcome as more types of polymers are developed.

CONDUIT. Utility companies are sponsoring an increasing usage of polyethylene piping as conduit for power and telephone lines. Conduits are used underground and in water, are embedded in concrete, and are also suspended from poles for short distances. Pipe up to 6-in. dia. is used. In humid areas, telephone lines are sometimes laid inside polyethylene pipe.

SWIMMING POOLS AND SKATING RINKS (1957: 3 million lb., 1960: 6 million lb.) *Swimming Pool Age* reports that 44,000 swimming pools were built during 1957, of which 30,500 were private residential pools; an increasing number will probably be built

such as those produced by Allied Chemical have recently pushed the frontiers of pipe pressures up approximately 50%, and of temperatures up some 25 percent. Such products also apparently exhibit much better resistance to stress and fatigue cracking and to slitting.

Many laboratories are seeking ways to improve polyethylene by irradiation. High-energy irradiation of polyethylene with gamma rays changes the character of the resin from a thermoplastic to a thermosetting type. Especially when carbon black is incorporated, heat resistance as high as 500° F. has been reported. This may, of course, open up some new applications in the pipe field where high temperatures are encountered at atmospheric pressure.

A new competitor?

Every polyethylene manufacturer has closely watched new developments in polypropylene; this material, which has a completely different stereochemical structure than polyethylene, can be made in a variety of different polymers. Polypropylene can be made to range from rigid to flexible, depending on process conditions and catalyst systems used. For applications in the pipe field, polypropylene is said to possess all the advantages of polyethylene; in addition, its melting point is about 60° F. higher and it possesses greater tensile strength. Polypropylene can be treated with carbon black and antioxidants to produce an oxidation-inhibited material.

Summing up the many factors of this situation, it can be expected that polypropylene will become a serious competitor for polyethylene and will also open up complementary markets. There are indications, too, that copolymers of ethylene and propylene, and other olefins may result in materials of greater versatility.

Conclusion

Pricewise, polyethylene stands on firm ground against metal and concrete, but to attain really broad tonnage it is more imperative that performance be substantially improved. New polyethylene resins are available as a result of subjecting the monomer to a great variety of conditions during the polymerization period. The molecular structure is being rearranged in a number of different polymers and blends. Practically all the major producers of resin are making developmental quantities of improved resins, but with over a billion pounds of projected resin capacity there is a great deal of work to be done.—End

FUTURE USES *(continued)*

each year. Polyethylene pipe is well suited for supply lines in this application and should capture a large share of the market. On the average, each swimming pool requires about 150 ft. of 1, 1½, and 2 in. pipe. If only half of the new swimming pools use polyethylene, 3.3 million ft. of pipe, weighing more than 1,000,000 lb. would be required annually.

It is expected that thousands of new skating rinks will spring up during the next 10 years. Polyethylene has been used extensively to circulate the refrigerant in temporary skating rinks which are laid over baseball diamonds or tennis courts in the winter and removed during the summer. It is reported that nine public skating rinks were recently put down in Detroit using polyethylene pipe. In Kalamazoo, Mich., 11 miles of polyethylene pipe are used in a skating rink which measures 185 by 85 feet. The pipe is 1 in. in diameter with walls 1/10 in. thick. It is rated at 65 p.s.i. at 75° F. and at 125 p.s.i. at 5° F. In operation, 3700 gal. of brine are circulated through it at 35 p.s.i. In the spring the pipe is disconnected, taken up, and stored with 2640 gal. of brine in it.

MINE USAGE (1957: 2 million lb., 1960: 2 million lb.) Polyethylene pipe has been found to be almost ideal for piping off the acidic waters of mines, which pose corrosion problems with metal pipe lines. It can withstand rough usage and has a service life, in many mines, of 10 years or more. The availability of continuous lengths effects significant savings in installation costs. It is reported that one man can lay 1000 ft. of polyethylene pipe in a mine in one hour; five men require half a day to lay an equal length of steel pipe.

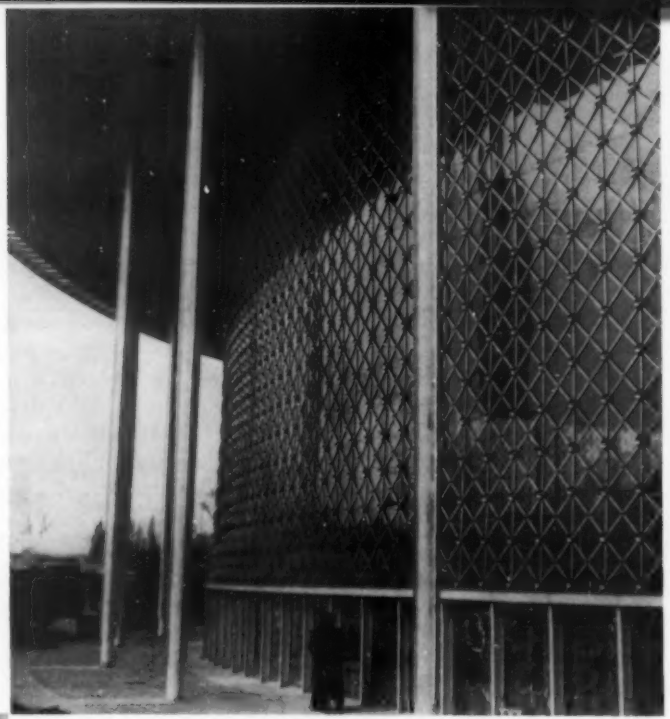
It has been found that the long-lasting qualities of polyethylene pipe even under severe service conditions hold down replacement demand and hence minimize the potential demand for mine usage generally.

Glen Alden Coal Corp. has used approximately 1 million ft. of polyethylene pipe during the past 8 years. Of this, 67% was 1 in., 23% was 2 in., and 10% was 3, 4, and 6 inch. The company used to employ groups of six to eight men for flushing with cast iron pipe; now such teams are made up of only two men.

TUBING AND CASES (1957: 5 million lb., 1960: 7 million lb.) While this report has primarily been confined to pipe, it should be pointed out that a considerable amount of thin-wall products are made, mainly in ⅝ and ¾ in. but also as high as 5 in. in diameter, for use as tubing or sheathing. A typical consumer application for thin-walled tubing is in containers for deodorant sticks.—End

Transparent vinyl wall

Laminated clear vinyl, less costly and lighter in weight than glass, is used in striking curtain wall which encloses U. S. pavilion at Brussels World's Fair



Curtain wall of clear rigid vinyl, 42.5 ft. high, extends around entire 1000-ft. circumference of U. S. pavilion at Brussels World's Fair. (Photos, Bakelite)

View through vinyl wall of workman adjusting a panel. Light weight of panels permits use of steel latticework for support

In translating the original design of the U. S. exhibit at Brussels into the finished structure, one of the most perplexing problems was the choice of material for the wall. (See "What plastics will star at the Brussels Fair?" Modern Plastics *34*, 198, April 1957.)

The requirements that had to be met were transparency, light weight, fire and shatter resistance, and a balance of rigidity and resiliency. Of all materials considered, rigid vinyl met them best.

Until the pavilion was erected, vinyl had never found usage in exterior walls. Available materials deteriorated on extended exposure to weather, gradually losing clarity and resiliency. Work on the development of a rigid vinyl for permanent outdoor use has been going on for some time; Bakelite Co.—one of the firms active in this area—was able to develop an improved material of intermediate permanence in time for use at the fair. While not a fully permanent outdoor vinyl—for which the search continues—its weathering characteristics are sufficiently improved to make it suitable for this purpose.

The vinyl wall, about 1000 ft. in circumference and 42.5 ft. in height, is composed of 4000 individual vinyl panels mounted on a steel latticework. Each panel measures 27 by 56 by 0.140 in. and weighs about 12 pounds. Total resin consumption for the wall was close to 50,000 pounds.

Panels are cut from sheets 54 by 120 in. in size. Each sheet is a lamination of 10 thinner-gage calendered and press-polished vinyl sheets (eight of 15 mils and two of 10 mils.) Laminated sheet is used because no extruded sheet in the thickness required is commercially available with the necessary degree of clarity.

Cost of the panels was $17.50 each, ready for installation. This, according to the manufacturer, is less than glass of the same thickness. In addition, vinyl is shatterproof and weighs only half as much as equivalent glass, making it possible to use a steel latticework rather than more costly steel mullions.

Credit: Panels laminated and fabricated by Laminations, Inc., Scranton, Pa.

Epoxy coating improves cameras

Production economies and better photographic results are brought about by coating inside surfaces of molded phenolic parts

Colored epoxy coatings for phenolics, developed about a year ago and hailed as glamorizers of plastics' work-horse, have extended phenolics' spectrum (black, brown, and maroon) to encompass practically every color in the rainbow—(see "Color for phenolics," MODERN PLASTICS *34*, 115, May 1957).

These coatings have now found a new application in a less glamorous but highly important field: the inside of molded phenolic camera parts. With cameras being produced at an annual rate of about 10 million units, the market potential for this application is considerable.

Why inside coatings?

The high surface gloss characteristic of molded phenolics, an important asset in most applications, is a detriment inside the camera. There it may bounce unwanted light to film or plate. Thus, camera manufacturers have generally tried to reduce this reflectivity by applying a non-reflective coating.

In the past, a conventional air-dry lacquer was used for this purpose; and it was often necessary to sandblast the part to assure proper adhesion of the coating. No sandblasting is necessary with the epoxy enamel since it will adhere to even the glossiest phenolic without any priming operation. Cost of the epoxy coating can be as low as 1¢/sq. foot.

A typical example of this use of epoxy coatings is found in Eastman Kodak Co.'s Apparatus and Optical Division. Here the interiors of Signet-40 cameras are coated with Rexclad-R, a black epoxy enamel formulated by Rexton Finishes, Inc., Irvington, N. J., and based on Epon resins (Shell Chemical Corp.). The coating has a dull finish with a scanning incidence gloss of zero.

The material is a two component system, consisting of resin and hardener which are mixed together just prior to use. Pot-life of the mixture is approximately 36 hours. Cure to the point where items may be handled on the assembly line can be obtained by either air-drying for 2 hr. at room temperature, force-drying at 140° F. for 10 min., or baking at 250° F. for 1 hr.; the choice depends on scheduling requirements but does not affect properties.

At Kodak, after the interiors have been sprayed with the enamel, the camera bodies are loaded onto metal trays which are placed into 20-tier racks. The racks are connected to a conveyor which carries the camera bodies through a force-dry oven where the coating cures to a hard, chip-proof, scuff-resistant surface. From the oven, the parts go to visual spot inspection and from there to the production line where the cameras are assembled.—END

Interior of molded camera body is sprayed with epoxy finish to eliminate reflectivity. Rack filled with parts already sprayed (right) will go through force-dry oven to cure coating. (Photo, Shell Chemical Corp.)

Fig. 1: The AGN-201 portable reactor and its control console. Polyethylene-moderated reactor is shielded with graphite, lead, and water; can be installed in any room without additional shielding. (Photo, Aerojet-General Nucleonics)

The moderator is polyethylene

Ease of handling and operating safety in small mass-produced nuclear reactors have been improved through the use of polyethylene and polystyrene elements. These reactors are used for making and storing small quantities of short-lived isotopes for research into the nature of radiation and its effects on materials and living tissues, for some kinds of process control work, and for demonstrational purposes in the teaching of nuclear science and engineering. In such a reactor, where the neutron-generation rate must be kept relatively low, the fissionable material, such as uranium (U-235), must be diluted with a moderating material that slows down the neutrons and absorbs some of their energy as heat. Some of the neutrons generated strike other than U-235 atoms, causing them to split apart and release more neutrons. By carefully proportioning the U-235 and moderator, it is possible to make a self-sustaining, or "critical," reactor. The chain reaction is started by introducing a neutron source, then easing into the reactive core some rods containing small extra amounts of fuel. These rods may be quickly retracted to stop the reaction.

One of the best moderator materials is hydrogen. However, under normal conditions, pure hydrogen is an explosively inflammable gas, and there is relatively little hydrogen in a given space—less than $\frac{1}{10}$ of an ounce for each cubic foot. But in the form of liquid water (H_2O), there are 110 oz. of hydrogen per cubic foot, more than a thousand times as much. Polyethylene $(—CH_2—)_n$ contains even more hydrogen—131 oz./cu. ft.—than water.

Polyethylene is also safer to use as a moderator than water. As stated by Aerojet-General Nucleonics, San Ramon, Calif., builder of mass-produced reactors, slabs of uranium-impregnated resin are much easier and safer to handle than water solutions of radioactive uranium salts. Polyethylene also has an advantage from the user's point of view; the high thermal-expansion coefficient of the material will cause the chain reaction in the AGN-201 reactor (Fig. 1, above) to cease if the temperature rises by more than 7° C. This added safety feature is most welcome in a reactor that is to be used by many persons who are not nucleonics specialists.

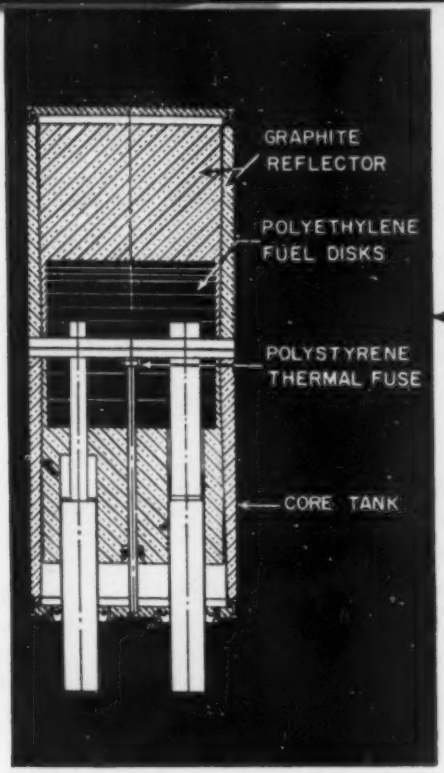


Fig. 2: Cross-section of core of research reactor, showing how "hot" core is built up of disks of polyethylene impregnated with uranium oxide; styrene fuse supports lower half

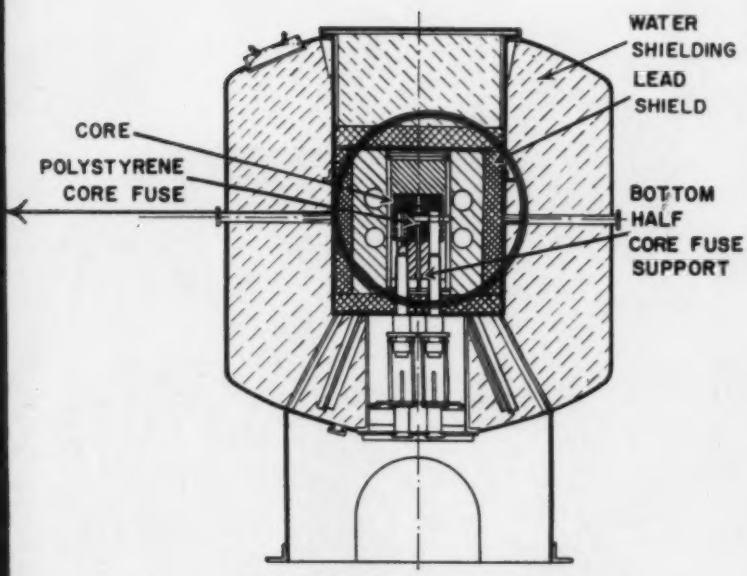


Fig. 3: Schematic cross-section of portable reactor, showing how core is surrounded by thick shield of borated water

Compact nuclear reactors for industrial research and educational uses have polyethylene cores and polystyrene fuses

Since polyethylene is cross-linked by radiation, the core won't soften and flow even at temperatures well above the point at which water would boil away.

While ionizing radiation does eventually tend to degrade the resin, short-term tests indicate that the polyethylene core should serve at least 300 years, providing the fuel is not "burned up." In the AGN-201 model reactor, the fuel will also last for centuries.

The models 201 and 211 of AGN differ in power and shielding, the core of the 211 being about twice the size of the 201 core. In the 211, the core elements are immersed in water.

The AGN-201 core (Fig. 2, above) is cylindrical, and is assembled from disk-shaped sections, the disks decreasing in thickness toward the top. This construction feature makes it easier to approach gradually the amount of fuel required for safe operation. (Accidental assembly of too much fuel could result in a runaway reaction. Special precautions are taken to make sure this cannot happen in the manufacture, transfer, and storage of the uranium-containing resin.) The uranium content, in the form of fine particles of 20% enriched UO_2, is about 1 g. of oxide for each 4 g. of polyethylene.

The AGN-201 is a very compact reactor—described as portable by its makers—with overall dimensions of 9 ft. tall by 6.5 ft. in diameter. The operator is protected from core radiation by layers of graphite, lead, and water.

One of the many safety devices of these reactors is a polystyrene fuse located in the center of the core of the 201 model. This fuse, in which the uranium is more highly concentrated than in the polyethylene, develops heat even faster than the rest of the core. It also supports, through a long rod (see Fig. 3), the lower half of the core. Should a power surge occur, this fuse would melt when its temperature reached approximately 100° C., the lower half of the core would fall away from the upper half, and the chain reaction would stop. Because polystyrene is not significantly cross-linked by radiation, its fusing temperature does not change with continued operation. Since the induced radioactivity in the polystyrene fuse is extremely small, the fuse may be handled and disassembled as readily as the core.—END

'Laminate art'—

"Children at Play," a decorative laminate mural for a New York City school, measures 8 by 12 ft., consists of 288 separately cut pieces cemented in position

Original sketch is projected onto white paper to bring it up to finished size. Muralist then reproduces pattern by tracing image with pencil. Next, each section will be numbered to identify colors and facilitate final assembly. The drawing is then cut apart and the numbered sections used as templets for cutting the melamine decorative laminate

Decorative plastics laminate sheet is emerging as a promising art medium of considerable potential in the interior decoration of institutional buildings, transportation facilities, offices, and other structures. While not yet large-volume, work already done in this material suggests that the application may ultimately grow into a sizable market.

The most recent example of "laminate art" is a mural commissioned by the New York Board of Education for one of the city's public schools. Specifications for the work stipulated that it be vandalproof. Since decorative laminate meets

Technician assembles cut laminate pieces to plywood backing, following original design. Each piece is cemented in place and held by wooden blocks until firmly bonded

new mural medium

Several techniques are now available for producing works of art that are permanent and easy to maintain

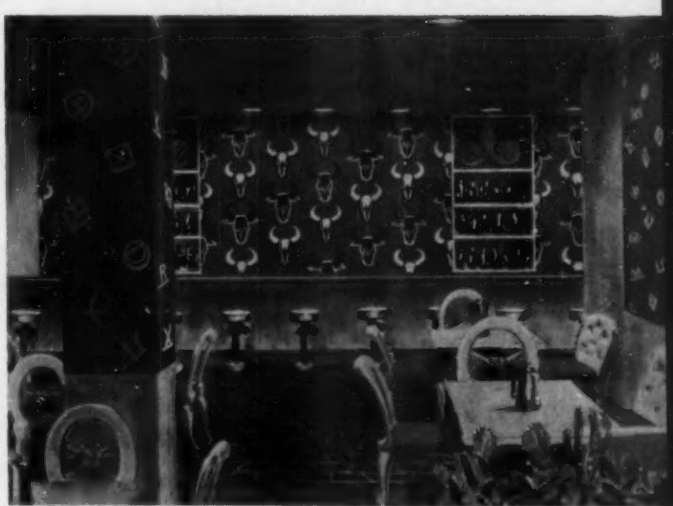
Mural commissioned for Xavier University is executed in "painting" technique. Work measures 20 ft. wide; since decorative laminate comes in maximum widths of 4 ft., finished mural is composed of five carefully matched sections. A score of such murals have recently been installed on the *SS. Empress of England,* new Canadian Pacific passenger liner. (Photo: Formica)

this requirement perfectly, muralist Stuyvesant Van Veen decided to execute the work in that material. The additional advantages that the laminates offer in resistance to color fading and cracking and their ease of cleaning also entered into the decision.

How it is done

The mural, which measures 8 by 12 ft., was produced in cooperation with the recently formed Decorative Art Dept. of Formica Corp., a subsidiary of American Cyanamid Co. The procedure was as follows:

The artist's original design was projected onto a large sheet of white paper to bring it up to finished dimensions, and the projection traced with pencil to produce a full-size outline of his work. Next, each section of the penciled mural was numbered to correspond to a specific color and shape of laminate. The sections were then cut out and used as templets (*To page* 172)



Laminate art in restaurant. Wall in back is covered with "artlay" type; column in foreground and wall at right are "inlay" types

PLASTICS PRODUCTS

Spare tire cover

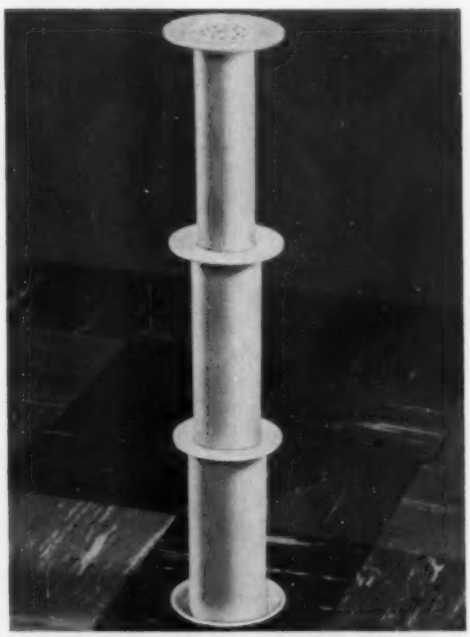
All those useful objects that often roll around loose in an auto trunk—flashlight, tools, auto polishes, wiping cloths, etc.—can be held securely in place with a Spare Tire Valet fabricated of polyethylene film. The Valet is a combination storage bag and protective covering that slips over the spare tire. Besides providing a number of storage pockets, the cover prevents luggage and clothing from becoming soiled by contact with the spare tire.

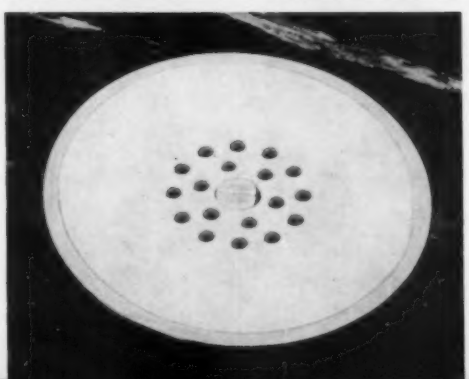
Credits: Manufactured by Crest Manufacturing Co., 5724 Cass St., Detroit, Mich., of Visqueen polyethylene film supplied by the Plastics Div., Visking Co., Terre Haute, Ind.

Acrylic standpipe

A new molded acrylic standpipe for basement drains will prevent flooding under adverse weather conditions. The unit, composed of four telescoping sections, functions as a normal floor drain except when rain or sewage water backs up in the drainage system due to heavy rain or melting snow. The standpipe begins to rise when the water pressure reaches 2½ lb., providing up to 32 in. of protection.

Credits: Molded by Cruver Manufacturing Co., 2460 W. Jackson Blvd., Chicago, Ill., of Implex modified acrylic from Rohm & Haas.





Kitchen pail

Polyethylene pails are invading the American kitchen on a big scale, and for a number of good reasons. They are virtually impossible to break, chip, or dent, even in the busiest kitchen. They will not rust and, as a special dividend, they are particularly pleasant to clean; unlike metal, they are completely noiseless in handling and cannot mar the sink during washing.

The latest entry in this field features a one-piece lid with an integrally molded hinge in the center, reinforced with a metal rod. The lid gives a tight seal, and can be opened from either side, which eliminates the necessity of removing the entire lid.

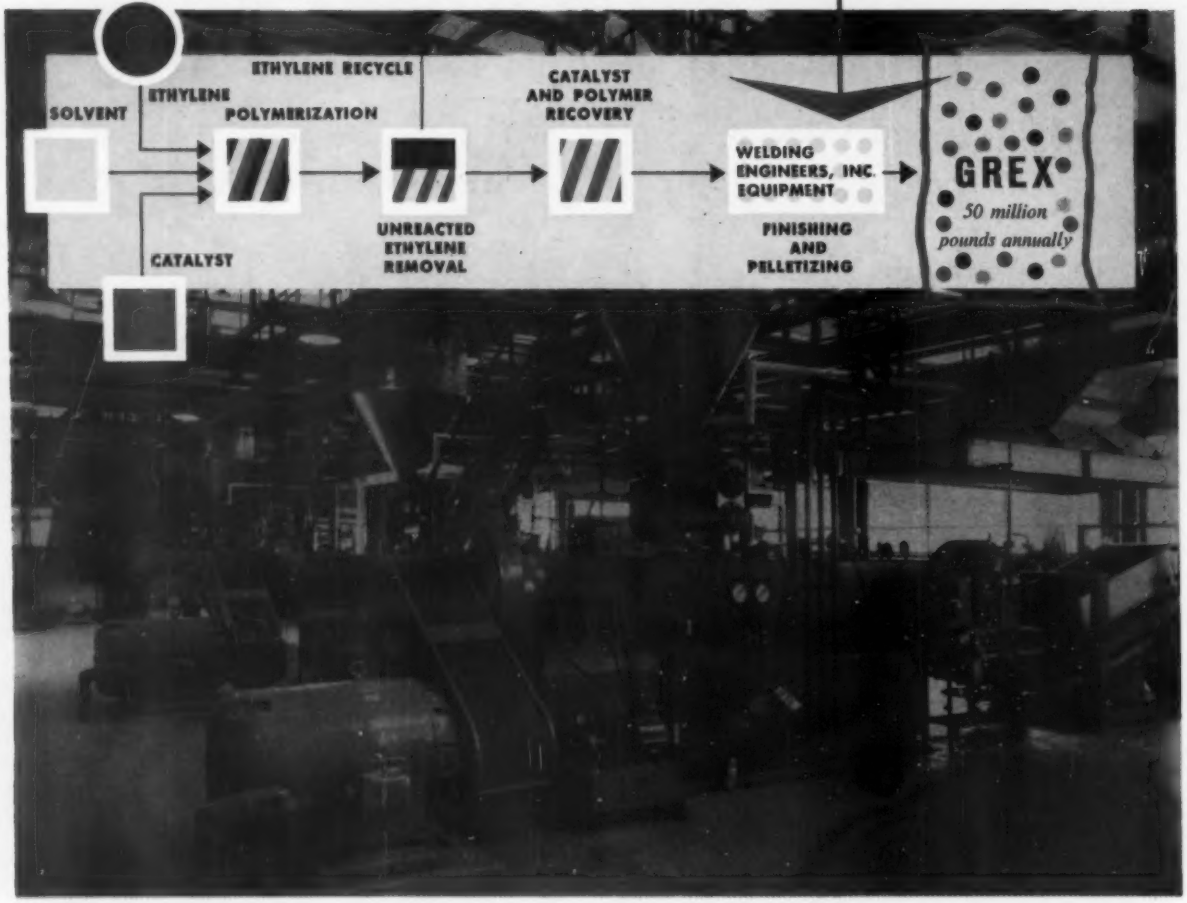
Credits: Molded by Victory Manufacturing Corp., 1722 W. Arcade Place, Chicago 12, Ill., of polyethylene supplied by Spencer Chemical Co., Kansas City, Mo.

Hot-dish covers

Thermoformed styrene copolymer dish covers offer two advantages which metal covers have always lacked: low thermal conductivity, which reduces heat loss in the food served; and less noise in use. In addition, the covers, designed for use by restaurants, hospitals, caterers, etc., are light, durable, and resistant to acids, soaps, and detergents. They are easy to clean and withstand normal dish washing temperatures. Manufactured in three sizes for dishes from 7¼ to 10⅛ in. in diameter, the covers have the advantages of stacking in use and nesting for storage. They are available in four colors as well as in a crackled decorative finish.

Credits: Manufactured by Cloverlane Div., Chicago Molded Products Corp., 1020 N. Kolmar Ave., Chicago, Ill., of Chicago Molded's Campcolite sheet.

GREX* in the making by W. R. Grace & Co. proves the performance ability of Welding Engineers' giant dual worm compounder-extractor-extruders. This is the vital finishing area of the new high density low pressure polyethylene plant at Baton Rouge. The flow chart by W. R. Grace & Co. graphically traces the process and shows the important role played by WEI equipment—for high quality, high rate, economical production.



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Dr. James F. Carley, Engineering Editor

Molding dry-colored polyethylene

Comparative effectiveness of nozzle inserts is revealed by viewing molded disks by transmitted light; a new breaker with many venturi-shaped holes is as effective as extrusion compounding

By Clifford L. Weir†

In standard injection molding machines, dry-colored resin, once melted, flows by straight laminar flow through the cylinder. This flow does not provide the high shear and intermixing needed to achieve good distribution of color in melt. In screw-type preplasticators or in cylinders with many stream-splitting restrictions, mixing is better; but such cylinder designs are rarely used in the United States.

To obtain a high degree of shear, adjacent layers of melt must flow at very different rates for a sufficiently long time. One way of accomplishing this is to force the stream through small holes at high rates. While a single orifice could achieve the shear desired, multiple orifices of the same length but smaller diameter, at the same flow rate and pressure drop, accomplish more shear. At the same time, the subdivision of the main stream into several smaller ones results in some intermixing when they rejoin.

In order to keep the pressure drop and breaker-plate thickness within reasonable limits, the orifices are made short. The illustration at right shows schematically a typical, multiple-orifice breaker plate fitted into the rear of the injection nozzle.

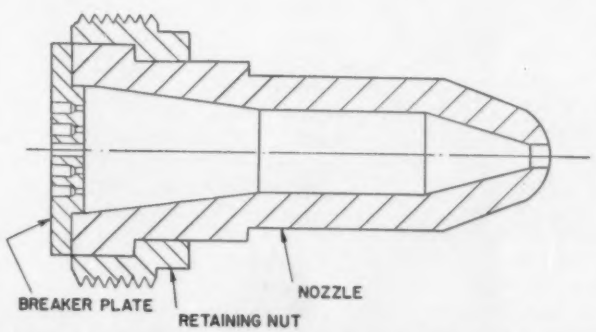
Wetting agents a hindrance

The object in dry coloring is to distribute the pigment as intimately as possible with the resin. Since the pigment particles become distributed over the surfaces of the molding pellets, the more of this surface there is, the better the distribution. Since there is more surface per unit weight in small pellets than in large, fine granulations are preferred for dry coloring. For similar reasons, the pigments should be ground to pass a 200-mesh screen—coarse pigments cannot be depended upon to yield good-looking moldings after dry-coloring.

Considerable experimentation in our laboratory has indicated, also, that lubricants and wetting agents are *not* helpful to distribution of pigments in dry-coloring high-density polyethylene. Rather, they cause agglomeration of the fine particles; this in turn results in streaks in the moldings.

Experimental program

In a search for a simple, effective coloring aid we evaluated several devices well known in the field, as well as a number of variations of venturi-type, multi-hole



Sketch showing how breaker plate fits into typical injection molding nozzle. Small nozzles may have so little internal area that not enough venturi-type holes can be included to make plate effective

*Reg. U. S. Pat Off.

†Technical Service Engineer, Polymer Chemicals Div., W. R. Grace & Co., Clifton, N. J.

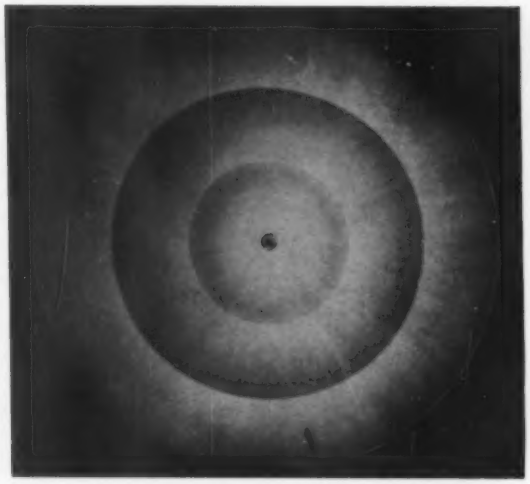


Fig. 1: Molding powder from which this disk was made was extrusion-compounded after dry coloring. High-contrast photo made by transmitted light shows a few light streaks but generally excellent color distribution

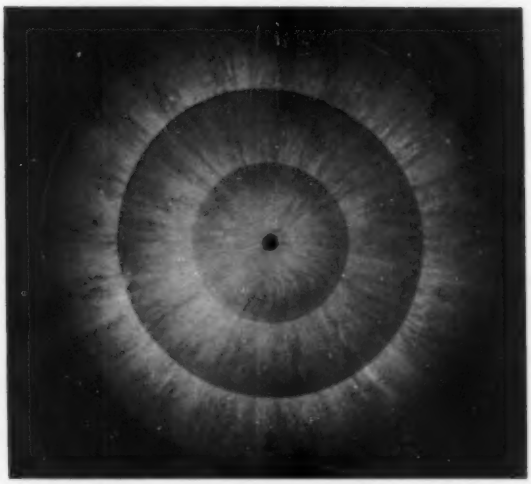


Fig. 2: Disk shown above was molded with no coloring aid other than a nozzle with 60-mil orifice. Distribution is poor

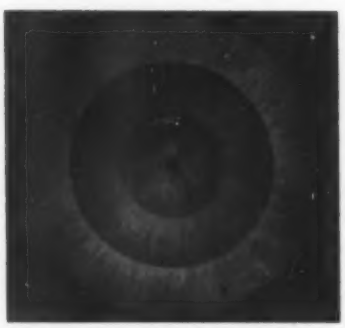


Fig. 3: Coloring aid here was small-orifice nozzle of Fig. 2 with long, thin approach channel

breaker plates that were developed in our laboratory.

The best test of the effectiveness of these aids is, of course, the quality of dispersion in injection-molded parts. The test piece used was a 9.8-in.-diameter disk, center-gated directly from a large sprue. The large diameters of nozzle orifice, sprue, and gate, the absence of runners, and the simplicity of the piece left the burden of achievement of shear and mixing to the coloring aid under test. The thickness of the disk is stepped—about 80 mils in the innermost 1.7 in., 65 mils between radii of 1.7 and 3.3 in., and 45 mils in the outer ring. It weighs 2.15 oz. without the sprue. Molding was done in a 12-oz. HPM injection machine.

The material used was high-density polyethylene of melt index = 5.0, colored by tumbling for 30 min. in a double-cone blender with 0.51% of red pigment,[1] with no wetting agents or lubricants. This pigment concentration was about right for observation of the degree of color uniformity in the disks by transmitted light. The disks were compared with disks molded, with no breaker plate, from extrusion-compounded material of the same composition as noted in Fig. 1, above.

The test disks were molded on a 45-sec. cycle at 10,000 p.s.i. ram pressure. This was the minimum pressure that would fill the cavity and produce a part free of sinks. Cylinder temperature was 450° F.; mold temperature was maintained at 110° F. by running temperature controlled water through the spiral channels of each half.

Figures 2 to 13 show the disks obtained. The disk of Fig. 2, above, was obtained with no coloring aid other than a small nozzle orifice, 60 mils in diameter by ¼ in. long. The next disk (Fig. 3, left) was made using a nozzle like that of Fig. 2, but having an approach channel 8.5 in. long by 0.50 in. in diameter. Figure 4, above, shows a disk made with a standard breaker plate; Fig. 5, p. 99,

[1]Pigment was #1214 of Plastic Molders Supply Co., Inc., Fanwood, N. J.

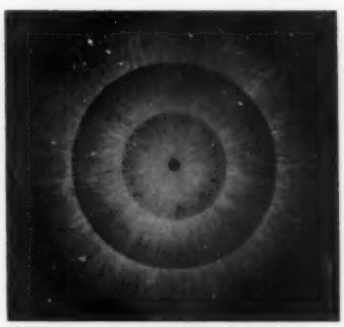
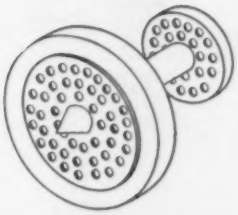


Fig. 4: Color distribution obtained with standard breaker plate (below) shows its ineffectiveness



DOUBLE BREAKER PLATE

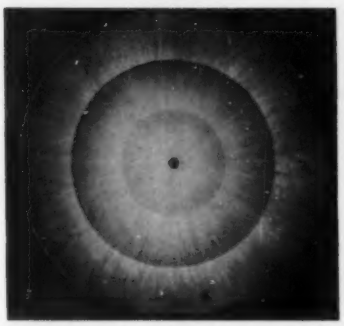


Fig. 5: Two breaker plates in series give distribution only slightly better than single plate—still poor

a disk made with a double breaker plate. While Fig. 5 shows some improvement over Figs. 2, 3, and 4, all patterns would be rated as poor in comparison with the extruded control.

Two other well-known coloring aids are the "polyliner" and "pineapple" nozzle inserts sold by Injection Molders Supply Co., Cleveland, Ohio. The polyliner insert was tested alone (Fig. 6, right) and in conjunction with a double breaker plate (Fig. 7, right). This combination was more successful than anything shown so far, but still not good. A sample disk made while using the pineapple insert alone is shown in Fig. 8, p. 102. A comparison of Figs. 5, 6, and 8 reveals that these three coloring aids were about equally effective with high-density polyethylene. Scott, Silas, and Smith (1)[2] got slightly better results with the double breaker plate than we did and did about as well with the IMS inserts.

The next five photos show the disks obtained with several modifications of the venturi-type breaker plate. The disk of Fig. 9, p. 102, was made with a plate like that of Fig. 10, p. 102, but there were only nine holes (no outer ring, inner ring located a little further from center). The disks of Figs. 9 and 10 are as different as night and day, showing how important it is to have the full number of holes. Comparing Fig. 10 with Fig. 1, it is evident that the 25-hole, full-venturi plate was at least as effective in color distribution as extrusion-compounding prior to molding.

Half-venturi also effective

Figures 11, 12, and 13, p. 103, show specimen disks made with half-venturi plates; that is, plates in which only the entrances to the orifices are tapered. The plate used in making the disk in Fig. 13 differed from that of Fig. 11 only in that the orifice diameter was 20 mils instead of 35. Note that the center holes of these three plates were all ⅛ in. straight through. Having a large center hole not only seems to improve the color distribution, but also reduces the pressure drop. Again, the effect of this small difference in design is tremendous; the coloring of disk 13 is very uniform—much better than that of disk 11. Other experiments have shown that the 60-mil land length is also a critical dimension.

The disk of Fig. 12 was made with a plate in which the holes were drilled at an angle. It was hoped that this would cause spiraling of the melt threads and improve intermixing. The result is not quite as good as that of Fig. 13, in which the same size holes were drilled vertically, so the more difficult and more expensive angular drilling is not recommended.

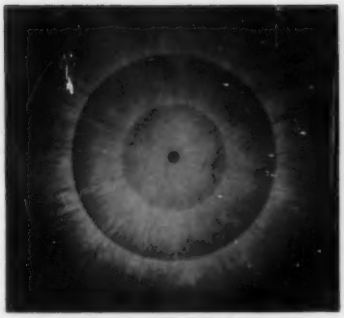
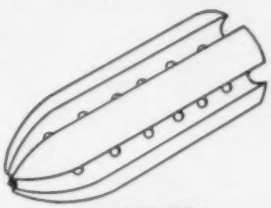


Fig. 6: Distribution obtained with "polyliner" insert (below) is about on a par with that of Fig. 5



POLYLINER

We also tested a plate made according to the recommendations given by Simpson (2). For a 2.5-oz. shot with a polyethylene of melt index = 5 and density = 0.95 this worked out to a single central hole with a dish-shaped exit, a diameter of 30 mils, and a land length of 100 mils. Unfortunately this disk was not pho-

(*To page* 102)

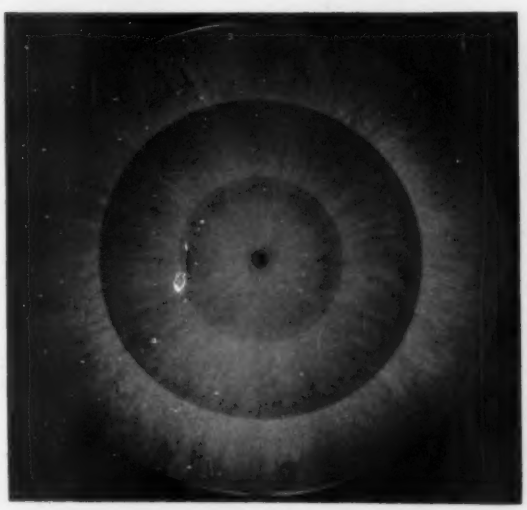
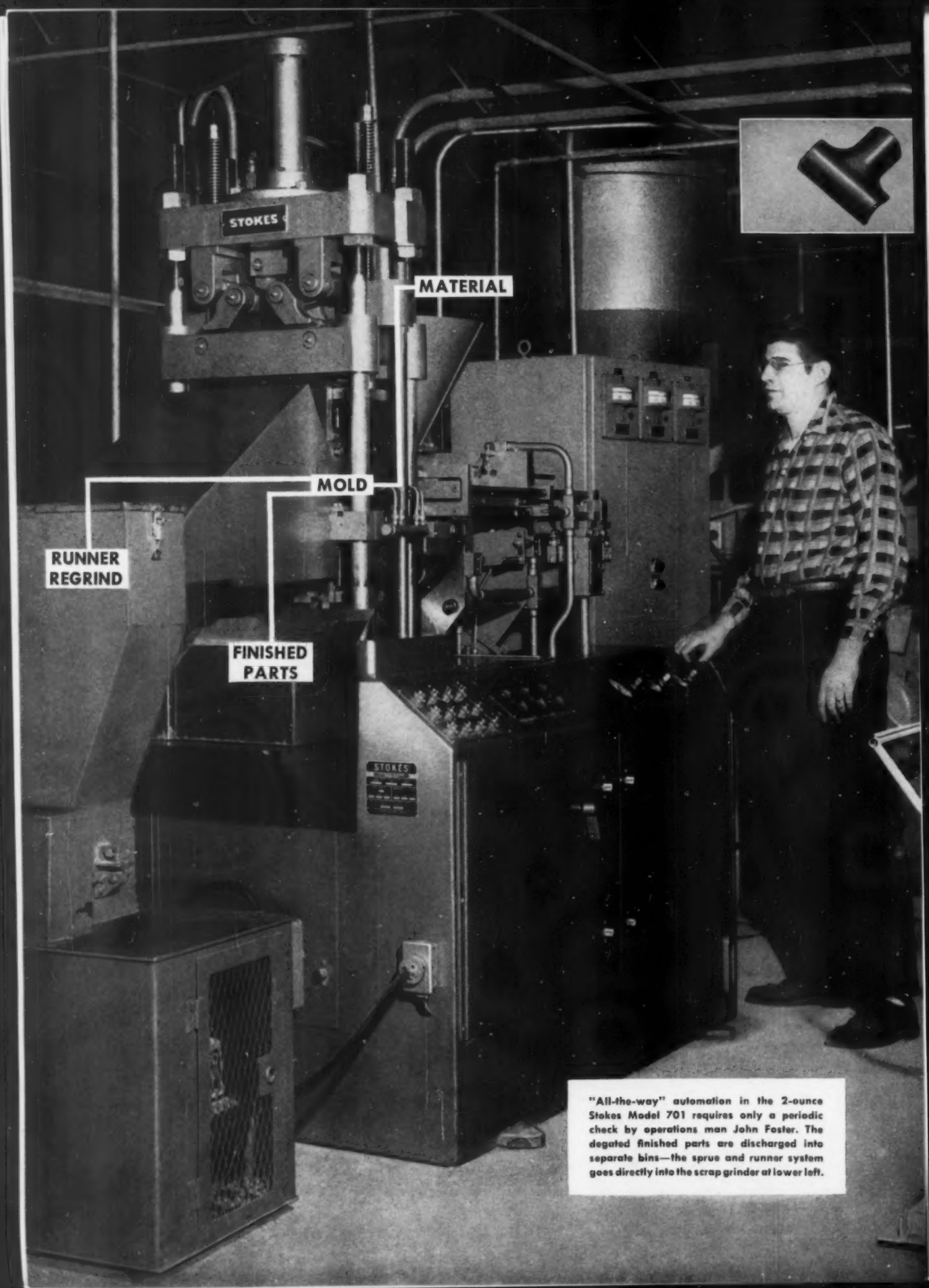


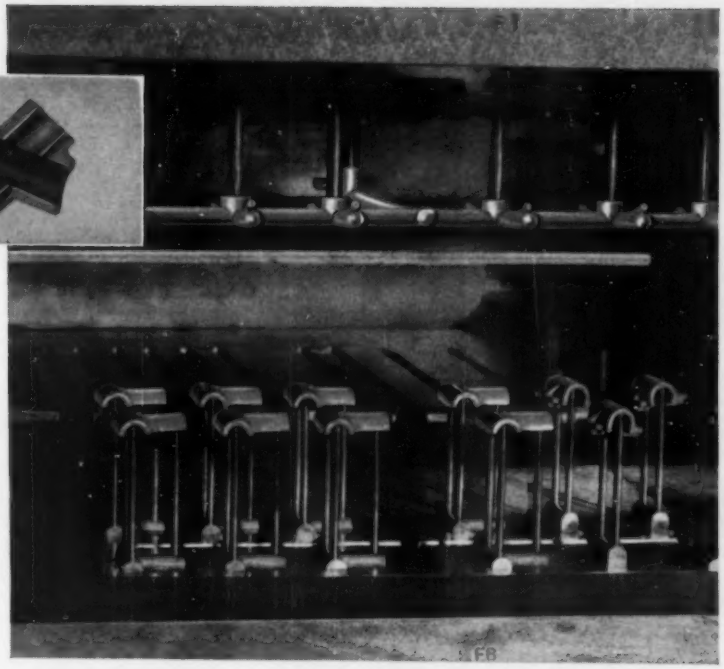
Fig. 7: Combination of polyliner and double breaker plate does better job than either; fair distribution

[2]Numbers in parentheses link to references listed at end of article, p. 103.



"All-the-way" automation in the 2-ounce Stokes Model 701 requires only a periodic check by operations man John Foster. The degated finished parts are discharged into separate bins—the sprue and runner system goes directly into the scrap grinder at lower left.

These are "Lok-links"—connecting links for the sectional fencing—made on the Stokes 701 fully automatic injection molding press.



A close-up of the die area shows the degated parts and runner system on their ejector pins —ready to be stripped off by the combs. The runner and parts are delivered to separate chutes. The three different parts, at right, are automatically sorted in a divided chute.

U. S. Metal Plastics chooses Stokes 701 injection machine for "all-the-way" automation

And what is "all-the-way" automation? It's Stokes' way of saying that the 701 injection molding machines are automatic from start to finish—they take molding material and deliver finished parts, separated and sorted from the runners and sprues . . . all without operator attention. That's automatic operation 'way beyond the point where ordinary machines stop.

Heart of this "all-the-way" approach is Stokes' automatic ejection and stripping system. When the die opens, the parts stay in one half, the runner system in the other. The knockout pins stroke, then the finished parts are combed off and pushed into a delivery chute. There are no sorting problems in family dies, since different parts are pushed into different sections of the chute.

This "all-the-way" automation is why U. S. Metal Plastics, Inc., of Laurel, Maryland, chose the versatile Stokes 2-ounce Model 701 for production of all their molded parts for garden fencing, weed guns and lawn coasters.

According to Edward A. Pierce, plant engineer, the 701 provides economical high speed production of their "Lok-links", the connecting links for sectional fencing, and other parts. An existing operator, tending an extrusion line, monitors the operation of the 701—thus adding no extra labor costs.

Savings of up to 40% have resulted from this "all-the-way" automation—and, in spite of a 20-hour-day, 6-day-week schedule, only routine maintenance has been required.

Write for your copy of literature on the Stokes 701 —the truly automatic 2-ounce injection molding machine. Ask for a Stokes production analysis on your own parts.

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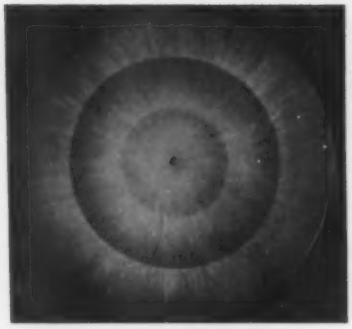


Fig. 8: "Pineapple" insert gives quality of color distribution in high-density polyethylene between those of Figs. 6 and 7

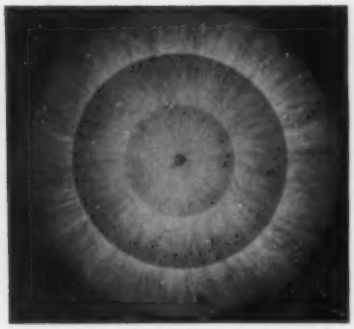


Fig. 9: Venturi-type plate with only nine holes, each with orifice diameter of 50 mils, gives relatively poor color distribution

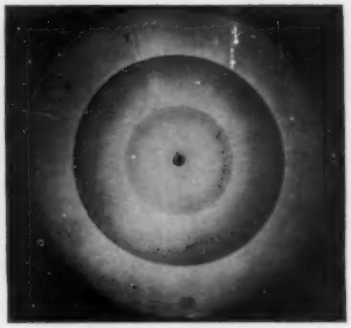
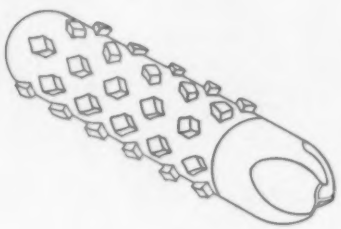


Fig. 10: Very good color distribution is obtained with plate of full-venturi type having 25 holes (see sketch below for details)



tographed; the evenness of coloring was fair—about equal to that of Fig. 12.

Restriction of flow

The ideal coloring aid, besides being inexpensive, easily installed, and effective in improving color distribution, should offer little or no resistance to flow. While there are molding jobs on which some additional pressure drop would impose no production penalty, there are others where a 1000-p.s.i. loss would require lengthening the cycle, closing off some cavities, enlarging gates, etc., or might even make it impossible to mold an acceptable product. Shallow wastebaskets with irregularly scalloped rims don't sell well, even if the color of the material is perfect!

To test the effects of a number of coloring aids on flow, a set of them were obtained to fit a 3-oz. Moslo machine for which we had a spiral-flow mold, a description of which is given in Ref. 3. The distance to which the melt flowed into this mold under standard conditions was measured with several of the coloring aids, using the flow distance with the nozzle alone as a basis of comparison. When the average flow distance with a particular aid had been determined, the pressure was gradually raised until the flow distance was equal to that (obtained at standard pressure) with the nozzle only. The required rise in pressure was recorded as a percentage of the standard. The results of these tests are presented in Table I, below. They show that the multi-hole venturi plates offer little resistance to flow, whereas the double breaker plate, the polyliner, and the single-hole venturi design significantly restrict flow. The pressure drop across these devices is converted to heat, raising the melt temperature some 5 to 15° F.

Raising the injection pressure improves color distribution but the improvement is small compared to that achieved at lower pressure with a better coloring aid. Lowering the cylinder temperature may also give better dispersion, but reduces resistance to

Table I: Flow in spiral mold with various coloring aids in nozzle

Coloring aid	*Average increase in pressure to maintain spiral length*	*Reduction in flow distance at standard pressure*
	%	%
No aid	0	0.00
Single breaker plate (Fig. 4)	5	7.00
Double breaker plate (Fig. 5)	10	8.00
Polyliner (Fig. 6)	10	8.00
Pineapple (Fig. 8)	5	7.15
Single hole	20	8.80
Full-venturi (Fig. 10)	2.5	2.00
Half-venturi (Fig. 13)	0	0.00

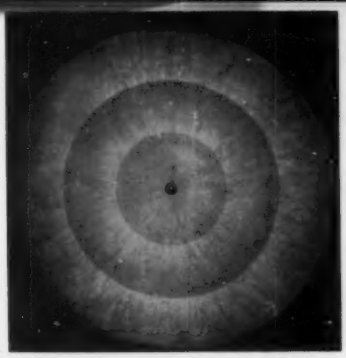


Fig. 11: Half-venturi type does poor job when holes are as large as 35 mils, even with 60-mil land length

environmental stress cracking and may cause "skinning"—local separation of surface layers.

Designing the plate

The design procedure given here is based solely on our experience with many modifications of the basic idea. It has been used to make plates for a number of production jobs, nearly all of them in high-density polyethylene, on items ranging from a thin-walled tumbler molded in a four-cavity mold in a 3-oz. machine, to a big wash basin molded on a 48-oz. machine. Other resins with which it has been used include linear polyethylene of 0.7 melt index, medium- and low-density polyethylenes, and polystyrene. So far it has resulted in satisfactory coloring of each item, and was actually the commercial salvation of some. It may turn out, however, that somewhat different dimensions will yield best results on other materials.

The procedure is simple. The plate is made essentially according to the sketch of Fig. 11, spacing and over-all dimensions being modified to fit the particular nozzle. There should be at least 16 holes, the center hole should be ⅛ in. all the way through, and the venturi holes should be 20 mils in diameter, 60 mils in land length. Counterbores are made with ⅛-in. drill. The material is oil-hardened tool steel with a Rockwell C hardness of about 50.

The full venturi design of Fig. 10 works about as well as the recommended half-venturi, but no better. Since it is more expensive to make, there seems to be no point in using it.

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2. Simpson, J. E., "A new breaker plate for coloring polyethylene," SPE J. *14*, 27 (March 1958).

3. Spaak, A., and C. L. Weir, "Molding linear polyethylene," Modern Plastics 35, 122 (March 1958).

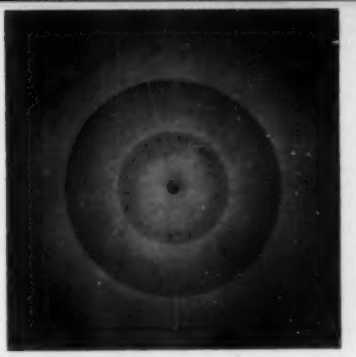

Fig. 12: When diameter of orifices of half-venturi is reduced to 20 mils and holes are tilted, color distribution is good

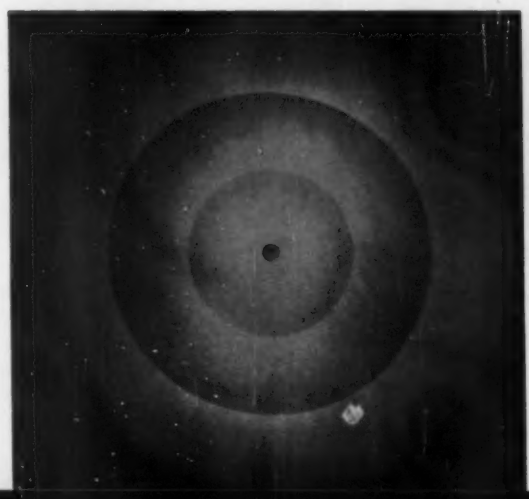

Fig. 13: Almost perfect distribution is obtained with half-venturi plate with vertical holes of 20-mil diameter and 60-mil land. Compare this with Fig. 1, p. 98.

Properties required of thermosets for automatic molding

Automation of thermoset molding for greater machine productivity requires materials that feed uniformly, are easily preheated, flow well, and cure rapidly to easily ejected, rigid pieces

*By Frank J. Donohue**

In common with other branches of the plastics industry, and with industry in general, the molders of thermosetting materials have, in the past 10 years, faced constantly rising manufacturing costs for labor, tools, materials, and shipping.

Confronted with this dilemma, progressive molders have sought all possible means to reduce costs and increase output. They have mechanized material handling, improved mold design and molding techniques, adopted semi-automatic and automatic finishing methods, and installed automatic compression- and transfer-molding equipment.

Press manufacturers have contributed greatly to this program, particularly in the past three years, by producing faster, more flexible, more versatile, higher-capacity, automatic presses which reduce to a minimum the idle time in the molding cycle.

Material suppliers have kept pace and sometimes have anticipated these changes with new, faster-curing, more uniform thermosetting materials having improved preheating and molding properties, to utilize fully the capabilities of these new presses and meet the molders' needs for higher production rates and lower molding costs.

Automatic molding equipment

Automation has become a by-word in American industry in the past five years. Often described in the popular press as an entirely new and radically different engineering concept, it has actually evolved from earlier and simpler ideas and forms. Many of today's automatic machines are remarkably ingenious combinations and developments of other, older mechanical and electrical devices which have been made capable not only of self-action, but also of self-control and self-correction.

Automation has not reached this stage of development or complexity in any part of the plastics molding field. But automatic molding of thermosets has been done for at least 20 years, and is growing rapidly in amount, particularly in proprietary or captive molding plants.

The first commercial, self-contained, automatic compression press, the Stokes-Zelov, was offered to the industry in 1936. This was a small, 15-ton mechanical press, with a platen area of only 6 by 8 in., an approach speed of 18 in./min., and limited stroke and opening.

In 1938, the Lauterbach rotary automatic compression molding press was introduced. This machine is designed for molding closures and circular parts symmetrical about a vertical center line and its maximum molding speed was greater than that of any of the thermosetting materials available at that time. Its advent gave powerful impetus to the development of faster curing thermosets.

During the intervening years, progress has been steady but, until recently, considerably slower than the development pace in the injection field. Capacity and speeds were increased and powder-feeding as well as part ejection devices were made more positive and flexible.

Today, automatic compression presses range from 15 to 450 tons, with maximum approach speeds of 360 to 400 in./min. Cycle control is precise and approach speeds, pressing speeds, and breathing cycles are adjustable over wide intervals. Borro(1)[1] has described many of these presses and their applications.

The increase in automatic molding has been particularly noteworthy in the last three years under the spur of rising labor and other molding costs. This method is now widely used by proprietary molders in the production of wiring-device parts, electrical switch parts, automotive wiring-accessories components, and multitudes of electronics-insulation parts.

Table I: Standard granulation for automatic molding

U. S. Standard screen size	*Percent retention*
12-mesh	0- 1
16-mesh	10-15
20-mesh	15-20
40-mesh	40-45
80-mesh	20-25
Pan	8-10

Material requirements

Certain basic properties in thermosets are very important for best performance in fast auto-

*Technical Service Manager, Thermosetting Molding Materials, Plastics Division, Monsanto Chemical Co., Springfield, Mass.

This article is based on a paper presented at the Jan. 1958, Annual Technical Conference of the Society of Plastics Engineers in Detroit, Mich.

[1]Numbers in parentheses link to references at end of article, p. 175.

Film of **TENITE POLYETHYLENE** is taking over many packaging jobs

Garment bags are a good example of the growing use of polyethylene film. When laundries or dry cleaners return garments in bags of polyethylene, your clothes are getting the best possible care.

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Toughness, waterproofness and transparency are only three reasons why film remains the biggest single market for polyethylene. Its heat-sealability makes it the logical choice for use in high-speed automatic packaging machines. Polyethylene is also the lightest of all plastics widely used for film—a pound of this film goes further than a pound of other plastic film of equal thickness. And because polyethylene resists chemical and solvent attack so well, this plastic is used to package merchandise ranging from pickles to battery acids.

If you need a film for packaging, investigate polyethylene. We'll be glad to help you explore the usefulness and usability of film extruded from Tenite Polyethylene.

For more information on this versatile plastic, write **EASTMAN CHEMICAL PRODUCTS, INC.**, subsidiary of Eastman Kodak Company, **KINGSPORT, TENNESSEE.**

TENITE
POLYETHYLENE
an Eastman plastic

Polyethylene film extruded by
Chippewa Plastics, Inc.,
Chippewa Falls, Wisconsin

Table II: Coarse granulation for bulk powder preheating

U. S. Standard screen size	*Percent retention*
10-mesh	2-6
12-mesh	6-13
16-mesh	17-25
20-mesh	16-21
60-mesh	32-42
80-mesh	0-8
Pan	0-2

matic presses: uniform, uninterrupted powder feed; good electronic preheating properties; rapid plastic flow and fast cure; excellent mold and flash release; and rigid set on ejection—and close batch-to-batch uniformity in all these properties.

These properties have always been desirable for semi-automatic molding; for automatic molding, they are practically mandatory. This article will deal with each of these attributes in turn, show why they are necessary, and give some idea of how they are obtained.

What is stated from this point on will apply most directly to phenolic materials, although the basic powder and molding properties listed are also necessary in ureas and melamines when used in automatic molds.

Powder feeding properties

Most modern commercial automatic presses are designed to handle loose powder. The volumetric metering methods used demand a special granulation in the molding compound to maintain uniformity of weight fed to the mold cavities. Particle form and shape, and particle size distribution are the most important characteristics.

The materials must be granular rather than flocculent, or if flocculent, as is the case with cotton-flock-filled, improved-impact types, they should preferably be pelleted, with compact rounded particles to avoid felting or interlacing in feed hoppers and loading-board bushings.

A good particle size distribution is the one given in Table I, p. 104, with approximately 15% retained on a U. S. Standard 16-mesh screen, and 10% passing an 80-mesh screen. This distribution, in a general-purpose phenolic material, with a molded specific gravity of 1.36, will yield a bulk density between 0.52 and 0.60 g./cc.

An improper mixture of coarse and fine particles in a given lot of material, for example, 20 to 25% on a 16-mesh screen, and 3 to 5% through 80-mesh, will tend to cause funneling and cascading in loading hoppers. This, and non-uniform flow into feed tubes, will cause erratic variations in mold charges, resulting in variable molded density or wasteful excess flash, may interfere with ejection, or may cause rejects due to short or unfilled pieces.

A high concentration of fines, on the other hand, with an otherwise normal particle size distribution, is almost certain to cause trouble with bridging in hoppers and feed tubes. Tubes may also block, particularly during low atmospheric relative humidity conditions, due to agglomeration of fine particles, caused by static charges.

High content of coarse particles (plus 12-mesh) is usually undesirable, except when bulk powder preheating is used; with such a concentration of coarse particles, flow is likely to be irregular, and the lower apparent density will necessitate larger feed tubes or cups to accommodate the necessary charge weight, and may require a larger loading well in the mold.

The necessary and proper granulation for automatic molding, with or without preheating, is obtained by suitable grinding and selective screening methods. There is nothing unique about the equipment used; it is similar in many respects to that used for grinding non-plastic materials. Techniques and problems differ, however, because phenolic molding materials are not as hard as mineral substances and all formulations are not equally crumbly.

Electronic preheating behavior

For certain high-production jobs, where extremely short cures are sought, the loose powder is preheated in special 80- to 100-mc. dielectric preheaters, using loading boards equipped with TFE fluorocarbon resin or porcelain feed tubes. The operation is continuous, automatic, and sequenced to the molding cycle by means of timers and limit switches.

The granulation used for cold powder loading may not be suitable in these cases, depending on the amount of preheat applied and the size of the feed tubes. The material may preheat unevenly, swell, and coalesce, and tend to jam in the feed tubes.

A special, coarse granulation has been developed to meet this situation, as shown in Table II, above. This heats more uniformly, and because of the greater percentage of voids or free space among the particles, shows less tendency to fuse; moisture evolved during preheating can more readily escape. As a result, there is less chance for the powder to pack and jam in the tubes.

It is desirable, ordinarily, to carry preheating only to incipient coalescence, not to the fusion point. On certain high production jobs, however, or with molds of

Table III: Cure times in commercial automatic molding

Part	*Section thickness*	*Method*	*Temperature*	*Cure time*
	in.		° F.	sec.
Wall plate	1/8	Compression	340	30
Switch housing	1/8	Compression	350	50
Fuse block	1/4	Compression[a]	380	45
Connector	1/8	Compression	360	40
Switch housing	3/8	Transfer[b]	380-400	24

[a]Dielectric preheat, bulk powder.
[b]Dielectric preheat, preforms.

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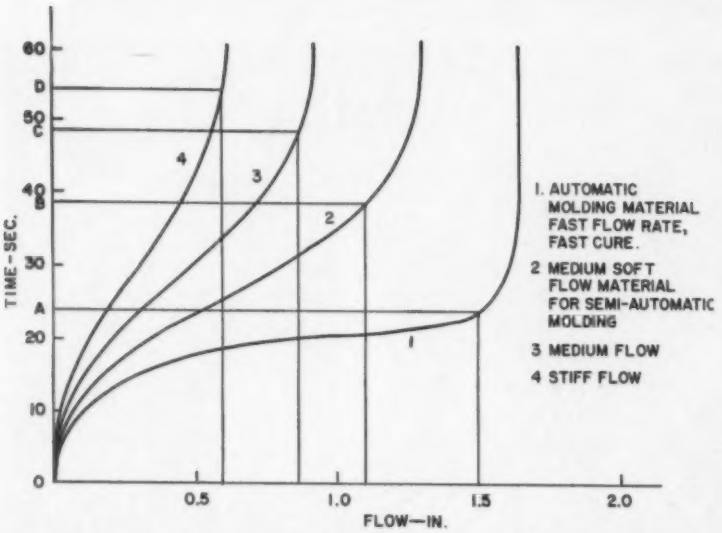


Fig. 1: Flow and cure properties of four phenolic molding materials

complicated cross-section, it is necessary to preheat the material to a high temperature (260 to 270° F.). In these cases, various mechanical devices may be needed to provide positive delivery to the mold cavities. These aids include burnished inside surfaces on feed tubes; reverse taper on inside walls of feed tubes; magnetic vibrator on loading board; and mechanical plungers.

The material should not, during preheating, evolve large quantities of moisture. This, together with dust from the powder, water-soluble volatile matter, and resinous exudate from the material will coat the feed tube walls and aggravate fouling and sticking.

Flow and cure

These two intimately related but opposed properties pose the greatest problem in developing materials for automatic molding. Molders have always, and with reason, sought the ideal general-purpose material—one with the softest flow and fastest cure. Soft, free flow means more cavities per mold and more parts per cycle; fast cure means more parts per hour. The sum total is lower molding cost and greater return per dollar of press and mold investment. Automatic molding, with its considerable initial cost, has sharpened this need.

Suppliers have met this challenge by developing resins of lower melt viscosity that produce molding compounds with faster flow rate, as well as faster cure, as illustrated in the somewhat idealized flow and cure curves in Fig. 1, above.

Curve 1 in that drawing illustrates the flow rate and cure time of phenolic material designed for fast-closing automatic presses. The curve is relatively flat, showing an extremely fast flow rate. The horizontal distance to the point where the curve turns sharply upward shows the total flow; the cure time is indicated by the vertical distance OA. This flow is accomplished in about 23 seconds.

Curve 3, in contrast, represents the molding behavior of one of the older medium-flow, fast-curing formulations of a few years ago. Its total flow, under the same conditions, is about one-half that of the material represented by Curve 1, and cure time of 48 sec., over twice as long.

What are considered fast cures in commercial automatic molding today? Obviously, production cycles will vary considerably with mold and part design and molding conditions. In Table III, p. 106, however, are some fairly typical examples obtained with general purpose automatic molding material.

Both one-stage and two-stage materials have been used to accomplish these results. One-stage resins and compounds are capable of very fast cures in many commercial automatic molds, especially at higher temperatures, but molding latitude is less, and preheating behavior more critical, as a rule, than with two-stage materials. Nevertheless, because of better odor characteristics, one-stage compounds are preferred for the molding of closures. Also, because they do not evolve ammonia, and, therefore, greatly minimize or eliminate corrosion of contacts and inserts in sealed electrical assemblies, one-stage compounds are specified for this use.

Resin type is not the only determining factor in flow and cure. While the fillers are the same as those used for years, new additives have been found and new compounding techniques devised to improve molding performance. New processing methods are continually being explored in the search for better compounds for automatic molding.

Mold and flash release

Good mold and flash release have always been important in thermoset molding in order to avoid warpage, distortion, and mold damage. In automatic molding this is doubly so, since failure of a molded part to release and eject cleanly from the mold may easily damage the mold due to double dosing or interrupt production frequently because of the operation of press safety devices. Even if this does not occur, gas trapping caused by adhering flash in mold clearance areas will often increase rejects.

Mold-release requirements are more exacting in automatic molds, where cold powder is used; higher back-pressures and frictional forces against mold surfaces are developed.

Insofar as the molding material is concerned, the best solution so far found is skillful compounding of resins, fillers, and lubricants. Chemists used to dealing with compounds of known composition with well defined physical and chemical properties might well consider this approach to be "cook-book chemistry." Yet to the polymer chemist and plastics engineer, these compounding procedures and the use of carefully chosen empirical tests, cor-

(*To page* 174)

Moisture, monster of metallizing, meets end in trap!

Metallizing operations become independent of humidity—cause of serious production slow-downs—by use of a mechanically refrigerated, quickly defrostable trap system

By Jack A. Selsmeyer and Howard M. Farrow†*

The arrival of hot, humid weather at just the time when highest production is frequently required has been a serious source of trouble for vacuum metallizers. Increases in humidity may also be caused by some plant operations. Whatever the reason, high humidity can greatly lengthen pump-down cycles, with consequent loss of production and high reject rates. An economical solution of the problem has been found in mechanically refrigerated defrostable cold traps.

Production vacuum-metallizing units are capable of reaching the coating pressure of 0.5 micron in less than 10 min. when fully loaded. Production schedules have been geared to take full advantage of such fast cycle times. A single machine coating small parts might employ 35 people in attendant operations such as jigging, organic base- and top-coating, cleaning, inspection, and packing. When humidity causes cycle time to jump 4- to 6-fold, the increase in machine time, while expensive, is inconsequential compared with the expense of unproductive labor. In addition, there are the embarrassments caused by unreliability of production schedules.

Adsorbed water vaporizes

At a room temperature of 80° F. the vapor pressure of water is about 26 millimeters. When a wet vacuum chamber is exhausted, the pressure falls to this value and the water, which has attached itself to the inside surfaces of the coating chamber, the work, and work holders, starts to vaporize. The vapor expands as the pressure decreases. By the time the pressure is reduced to 200 microns, most of the air has been removed and the load on the pumping system due to water vapor is many times the air load. The effects on pump-down time are shown in Fig. 1, below. The problem: how does one prevent the intake arrival, or speed the removal, of the water vapor.

Can't keep it out

Various methods have been used to reduce the amount of water which reaches the inside of the tank. Chemical and refrigerated driers have been applied to the air inlet so that the initial air vented into the chamber at the end of the metallizing cycle contains less moisture to be adsorbed on the surfaces. This precaution is effectively subverted when the chamber door is opened for unloading and loading, since this allows room air to enter. Also, on humid days, the parts loaded into the coater are literally saturated with moist air.

Efforts to exclude moisture from the coating room have met with only partial success. These include air conditioning, sealing doors and other openings, and dehumidification. A dehumidification system capable of maintaining the required 0.5-micron partial pressure of water would be out of the question financially and the operators would not be able to work in this less-than-desert dryness. At best, dehumidification can only help to reduce the problem.

The removal of accumulated water in the closed chamber offers more promise. Gas-ballasted me-

(*To page* 180)

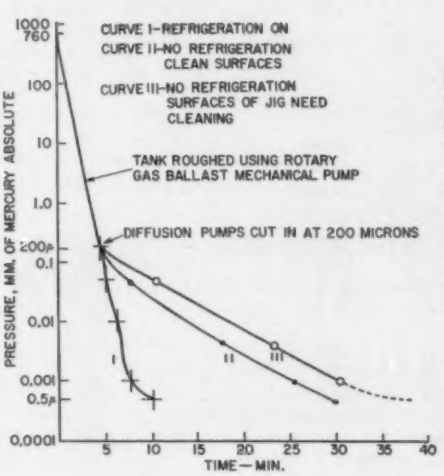
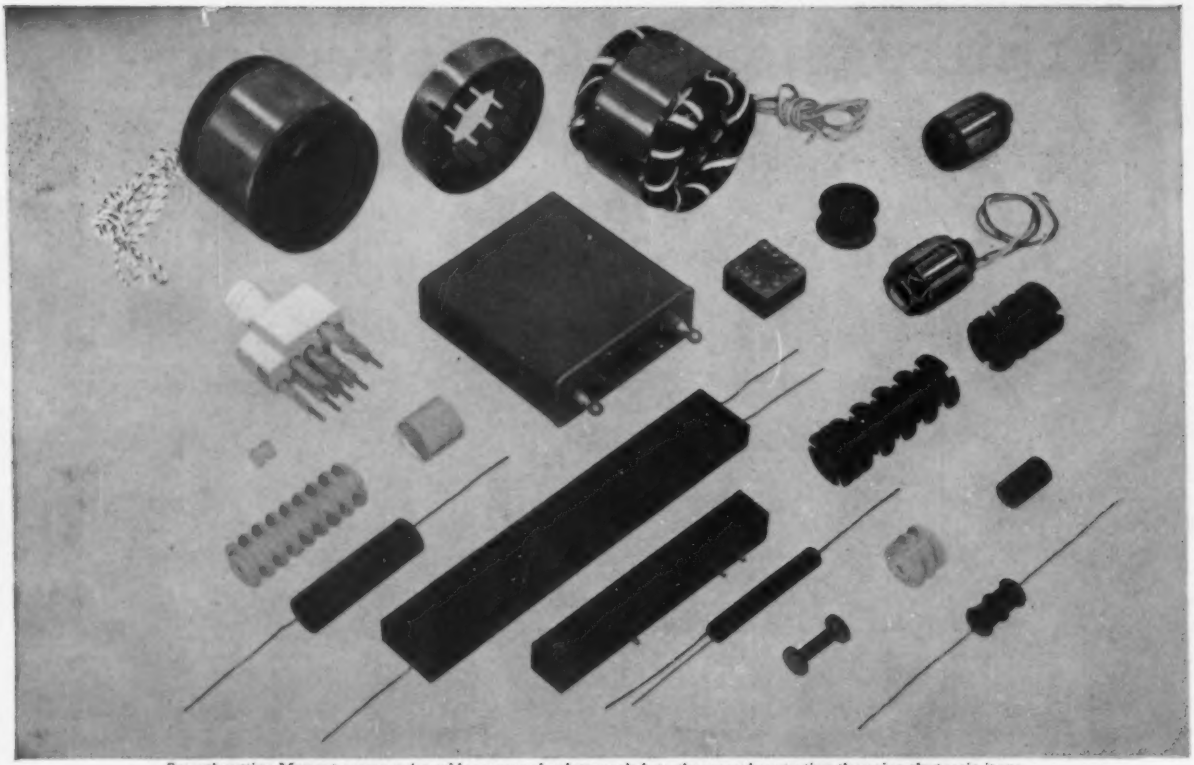


Fig. 1: With new cold trap NRC 5½-ft. coater equipped with two NRC 16-in. pumps will reach coating vacuum in less than 10 min.; 30 to 40 min. are required without trap, depending on cleanliness of chamber and jig. Difference in pump-down time between curves II and III shows importance of keeping inside of chamber and all fixtures as clean as possible

*Kent Plastics Corp., 1528 N. Fulton Ave., Evansville, Ind.
†NRC Equipment Corp., 160 Charlemont St., Newton Highlands 61, Mass.
Condensed from a paper presented at the 1957 fall conference of the Society of Vacuum Coaters.



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Plastics Technical Section

Dr. Gordon M. Kline, Technical Editor

Soviet polymer science today

By Herman F. Mark†

The Author: Dr. Mark, one of the world's best known polymer chemists, recently visited the U. S. S. R., where he gave four lectures before large audiences, conducted six seminars, and surveyed the important scientific institutions of Moscow and Leningrad in the field of chemistry. Some of his observations on Soviet research on polymers are presented in this report.

Dr. Mark was born in Vienna, Austria, in 1895. He obtained his Ph. D. from the University of Vienna in 1921, joined the Kaiser-Wilhelm Institut in 1922, went with I. G. Farbenindustrie in Ludwigshafen on Rhine in 1927, and became director of the First Chemical Institute at the University of Vienna in 1932. After the Nazi invasion, he was dismissed and left Europe in 1938 to become research manager of the Canadian International Paper Co. in Canada. In 1940 he became a professor of organic chemistry at the Polytechnic Institute of Brooklyn and was appointed director of the Polymer Research Institute in 1946.

Dr. Mark has published about 350 original and review articles. His principal research has been in the field of X-rays and electrons and their use in studying the structure of matter in the synthesis, characterization reactions, and properties of natural and synthetic macromolecules, such as cellulose, rubber, proteins, vinyl polymers, nylon, and other synthetic products.

Moscow

The 40-yr. old *Karpov Institute of Physical Chemistry* in the center of Moscow (Obuch Street 10) is under the direction of Prof. J. Kolotirkin with a number of distinguished scientists as department heads. It consists of three principal buildings with floor space of about 150,000 sq. ft. and is occupied by about 80 Ph. D. scientists and some 150 assistants, who are essentially devoted to basic research.

At the institute, Prof. B. A. Kargin directs the work of some 20 young scientists with the able assistance of Prof. G. L. Slonimski. One research group studies the mechanism of the formation of colloidal particles in aqueous phase from such systems as Al_2O_3, TiO_2, SiO_2, Fe_2O_3, and others by the combined application of electron diffraction, electron microscopy, light scattering, viscosity, and conductivity.

A relatively large room (about 900 sq. ft.) is completely filled with glass tubes several feet in length and 2 to 3 in. in diameter, in which accurate measurements of the rate and equilibrium of gas absorption by fibers and films are carried out. The results are correlated with density and small-angle X-ray diagrams and are evaluated in terms of a system of holes and fissures which influence water regain and dyestuff acceptance, but are also connected with fibrillation behavior and abrasion resistance. Kargin and Slonimski together also carry out systematic studies of solution viscosities at low concentrations and low shear rates and are now testing the validity of a novel type of equation which permits computation of the molecular weight of a polymer from its solutions or its melt (J. Phys. Chem. *30*, 1929, 1746, 1941; 1956).

The department of chemical kinetics is under the direction of Prof. S. S. Medvedev, veteran expert of polymerization mechanism from the days of gas phase butadiene polymerization and of the first redox systems. Part of his interest revolves around relative reactivities of free radicals in solution. In addition to conventional study of the chemical composition of copolymers as a function of the monomer feed, he has added systematic investigation of the rate of copolymerization and of the molecular weight of the resulting products. This is being done with a series of monomers which are so selected that the influence of the substituent or substituents at the double bond on its reactivity can be evaluated.

Much systematic effort is concentrated on the laws of ionic copolymerization, particularly

*Reg. U. S. Pat. Off.
†Director, Polymer Research Institute, Polytechnic Institute of Brooklyn.

cationic copolymerization of butadiene and isoprene with styrene and several of its derivatives; catalysts are $SnCl_4$ and $TiCl_4$ with HCl or H_2O as co-catalyst (J. Phys. Chem. *30*, 1752; 1956. Dokl. Acad. Nauk. *100*, 925; 1955. Ibid. *106*, 1034; 1956). The analysis culminates in the presentation of two equations for the rate and the molecular weight which are in good agreement with experiment over a wide range of all existing variables.

Another team of young scientists investigates the degradation of macromolecules with high energy radiation and the kinetics which control depolymerization and chain transfer.

Pioneering type of work is now being initiated on the mechanism of the formation of omega polymers ("popcorn" polymers), which are usually considered as valueless and undesirable. Their high softening characteristics and insolubility, however, represent desirable features which could be properly utilized if a sufficient control could be exerted on the degree of omega reaction. To gain this kind of control is the object of this work.

Degradation, crosslinking, and grafting of a variety of polymers is carried out with the aid of a rather strong Co^{60} source (20,000 c. equivalent).

University of Moscow: Prof. Nikolain Semenov, Nobel Prize Winner and Secretary of the Chemistry Division of the Academy of Sciences, directs the work of some 30 graduate students and research fellows which is focused on the mechanism of fundamental organic reactions which are initiated by free radicals. Prof. Semenov has also recently developed a keen interest in the mechanism of macromolecular chain reactions and in the properties of rigid, tough, and transparent polymers.

Precise instruments

Prof. P. A. Rehbinder's laboratory at the University of Moscow is particularly distinguished by a series of extremely precise instruments to measure the viscosity and elasticity of polymer solutions and gels over a wide range of shear stresses and deformation velocities; there is also in use an adiabatic calorimeter of high sensitivity which permits the determination of small amounts of heat given off over long periods of time. It is very useful to measure slow absorption processes such as the moisture regain of fibers and ceramics or to determine slow crystallization in organic and inorganic polymers (Coll. J. *18*, 429, 540; 1956. Dokl. Acad. Nauk *114*, 146; 1957).

Left to right: Prof. B. A. Kargin, director of Karpov Institute of Physical Chemistry; Prof. Kreutsel, associate director of the Institute of Oil and Coal Research; and the author

A group of research fellows is engaged in clarifying the elementary steps of the rupture of amorphous and crystalline solids. Stress cracking of highly crystalline organic and inorganic solids such as polyethylene or certain clays under the environmental influence of certain surface active agents is always considered to be a nuisance and most people try to avoid it. However, for certain uses one would like to have a drastic reduction in the mechanical strength of solids such as in breaking up rocks, drilling for oil and water, digging ditches, or the preparing of fine emulsions. As a consequence, Prof. Rehbinder studies the influence of highly surface active agents (and particularly mixtures of them) on the brittleness of a wide variety of solids. The first results have led to the idea that the molecules of these agents penetrate into the finest crevices and cracks of the solid surface and, if the system is under stress (particularly biaxial stress), act "like a wedge" in "plasticizing" or "dissolving" the atomic or ionic bonds at the apex of the crack where the tension is so high that a small additional environmental effect may lead to rupture. This intriguing concept is now tested under a variety of conditions and has already led to interesting results in the embrittlements of clays and soils.

Electron microscope studies

On the premises of the University there is also another laboratory which operates under Prof. Kargin's direction. Jointly with Prof. P. B. Koslov, he investigates the mechanical properties of isotactic polypropylene and polystyrene and the solution behavior of block and graft copolymers. Special interest is also focused on the shape of polyelectrolyte molecules in solutions of different pH. With the aid of an electron microscope of high resolving power it has been directly demonstrated how the spherical uncharged particles of a dissolved polyelectrolyte gradually are extended into rod and chainlike shapes as they are progressively charged by the dissociation of the acid or basic groups, which they carry (Coll. J. *17*, 196; 1955. J. Pol. Sci., May 1958). Prof. Koslov has recently engaged in a study of the supermolecular structure of films. Beginning with cellulose triacetate he uses vapor permeability, mechanical properties, density, and dyestuff absorption to establish the structural differences of the various layers of solvents or melt-cast films.

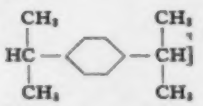
In his University laboratory, Prof. Kargin is also carrying out X-ray, electron diffraction, and electron microscope experiments to test his ideas on the crystalline amorphous character of linear macromolecular systems. He feels that the arbitrary distinction of a crystalline and an amorphous part is an oversimplification which cannot explain the complicated relaxation spectrum of polymeric substances and has to be replaced by a multiphase concept similar to the lateral order distribution proposed by Howsmon and his co-workers. There was some interesting discussion

on the thermodynamics of systems in which the various phases are distributed over the macromolecules instead of (as usual) the individual molecules being distributed over the phases.

The Institute of Element Organic Compounds (Leninski Prospect 31) under the directorship of Prof. A. Nesmijanov, President of the Acadamy of Sciences, consists of several two-story buildings with floor space of about 100,000 sq. ft. which offers not too modern, but very adequately equipped laboratories for a staff of about 12 professors, 100 graduate chemists, and 200 helpers. It belongs to the Academy of Sciences and is essentially devoted to the synthesis of organic compounds which contain "inorganic" elements such as P, F, Mg, Al, Si, Ti, and other heavy metals, partly because of their unusual reactivity, partly because of the high stability of micro- and macromolecules of this type. Nesmijanov himself is active in research on ferrocene-type compounds on a broad systematic basis including vinyl and allyl derivatives, dicarboxylic acids, and other polymerizable derivatives. Together with Mrs. Freidlina he has prepared a series of omega aminocarboxylic acids by the telomerized polymerization of ethylene at high pressures. Using CCl_4 as a chain transfer agent one arrives at hydroxy acids with 5, 7, 9, and 11 carbon atoms if one hydrolyzes the CCl_3 group and replaces the chlorine at the other end of the chain by NH_2. Reacting the terminal chlorine with KCN and reducing the CN-group to CH_2NH_2 one can also arrive at even numbered chains. A series of polyamides have been prepared from these products and one of them—the polyoenantic acid amide—gives a nylon type fiber which is now being produced on pilot plant scale as continuous filament staple fiber.

New method of polymerization

Prof. Korschak, Associate Director of the Institute and famous author of a two volume textbook on polymer chemistry, is preparing a series of very interesting polymers by a new principle: polymerization through bifunctional recombination at moderate temperatures. By the reaction of



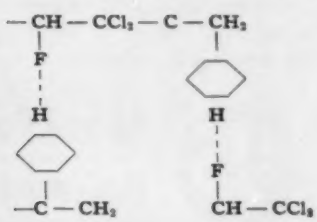
with *t*-butylhydroperoxide the tertiary hydrogen atoms of the aromatic molecule are abstracted and a chain molecule, similar to the high temperature Szwarc polymer, is formed by a sequence of bimolecular recombination steps. Because of the low temperature there are no complicating side reactions and one obtains linear soluble products of high melting points which can be molded, cast, and spun. Other diisopropyl compounds such as diisopropylferrocene and diphenyl diisopropylsilicate can be polymerized in a similar manner. Another interesting group of bifunctional molecules is based on the

skeleton where R is CH_3 or C_6H_5 and X can be OH, COOH, SO_3H, and NH_2. Linear polymers of these molecules comprise polyester, polyamide, and epoxy compounds.

Another interesting discovery in Prof. Korschak's group is the fact that the copolymerization of $CH_2=N\equiv N$ and $C_6H_5CH=N\equiv N$ in ethanol solution with BF_3 leads to a polystyrene which contains a considerable amount of isotactic material.

Still another team works on the polymerization of vinyl compounds with boron alkyl catalysts, such as triethyl-, tributyl- and triisobutylboron. Linear polymers of vinyl acetate, vinyl chloride, styrene, methyl acrylate, methyl methacrylate, and acrylonitrile have been obtained in solution and suspension. The reaction products of BF_3 and $B(Butyl)_3$ have been found to be good catalysts for the polymerization of ethylene and propylene under conditions similar to the Ziegler and Natta reactions.

An interesting observation is the fact that copolymers of styrene and vinylfluorine type polymers have higher softening points than the pure polymers of the individual components. For instance: polystyrene softens at 80° C., poly—(CHF-CCl_2)—at 85° C., whereas a 1:1 copolymer softens above 120° C. This fact is explained by the possible establishment of intermolecular hydrogen bonds according to the scheme



In this manner, aromatic residues and fluorine atoms together pro-

Prof. Mark (left) works out a problem with Prof. A. A. Korotkov, Prof. S. E. Bresler, and their assistants at the Institute of Macromolecular Chemistry in Leningrad

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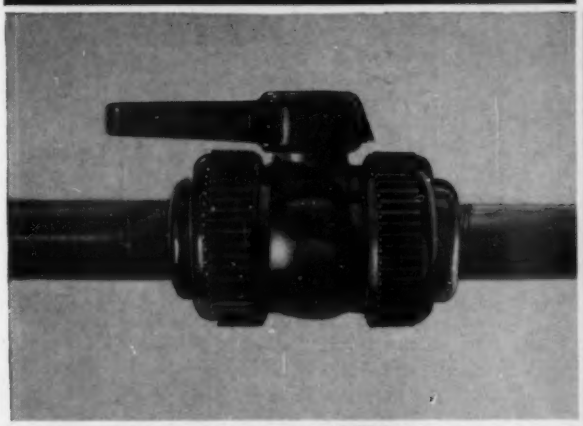

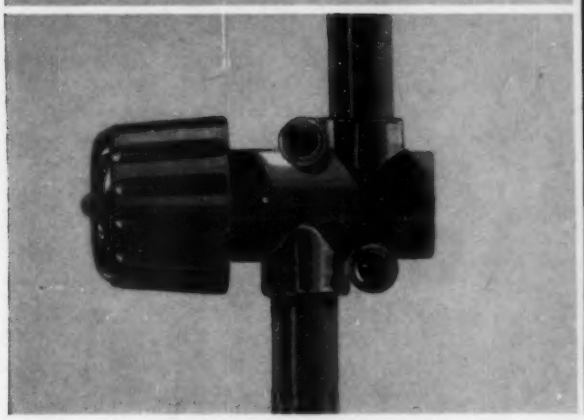

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Herman F. Mark (left) in discussion with Prof. M. M. Koton, director of the Organic Synthesis Division of the Institute of Macromolecular Chemistry in Leningrad

vide for nylon-type hydrogen-bond crosslinking.

Systematic and intensive work is going on under Prof. K. Andrianov and his colleagues on the synthesis of B, F, P, Si, Al, and Ti containing monomers which can be converted into high softening, heat resistant rubbers, plastics, and fibers.

In the domain of polymer structure Prof. A. I. Kitaigorodski is carrying out X-ray studies of polyethylene and stereospecific olefin polymers. He has found (as others have independently) a triclinic modification of linear polyethylene which has a characteristic chain packing and corresponding mechanical and thermal properties.

The Institute of Oil and Coal Research of the Academy of Sciences (Leninski Prospect 33) consists of an assembly of relatively old, smaller units with one larger central building of about 50,000 sq. ft. floor space; it is directed by Prof. Alexander Topchied, General Secretary of the Academy of Sciences, with Prof. Kreutsel as Associate Director. There are about six or eight other supervisors of professional rank, some 60 to 80 Ph. D. level research fellows and about 200 assistants.

Systematic studies are under way on the high pressure polymerization of ethylene with the aim to arrive at precise and reproducible degrees of branching and molecular weight by variations of rate and extent of conversion, pressure, and temperature. All facilities are available to establish the structural details of the products obtained and to test their technical behavior. Dr. Garber, who is in charge of the high-pressure division, also supervises a team of assistants who work on various syntheses from N_2, CO, and H_2.

Low-pressure polymerization of olefins

In the low-pressure range, all existing methods to polymerize and copolymerize ethylene, propylene, and other alpha olefins are given considerable attention, such as the use of the Ziegler and Natta methods and particularly the application of activated oxide catalysts according to the Indiana and Phillips processes. Fixed and fluid bed systems are studied and special efforts are directed to the improvement of the performance of these systems in the stereospecific polymerization of propylene and in the copolymerization of ethylene with propylene and butylene. Interesting and promising results are also obtained with boron alkyl and boron halide—boron alkyl catalysts which are studied by G. S. Koselnikov and his group (Izv. Akad. Nauk 2, 236 and 652; 1957) in view of their capacity to polymerize and copolymerize vinyl monomers and simple olefins.

The Institute of Organic Chemistry also belongs to the Akademi Nauk and is situated on Leninski Prospect in the neighborhood of the Oil and Coal Research Institute. Prof. B. Kasanski, who directs the efforts of some 12 professors and 200 research workers in laboratories of about 200,000 sq. ft., is essentially interested in classical organic chemistry, particularly the synthesis of vitamins, hormones, antibiotics, dyestuffs, insecticides, plasticizers, and surface active agents.

Cellulose research

A round table conference on the present state of cellulose research, held at the Institute, was attended by Profs. Kargin and Rehbinder of the Academy and by the following representatives of cellulose chemistry: Prof. Usmanov, director of a large cellulose research institute which the Academy of Sciences maintains in Tashkent, Usbekstan, and Profs. A. Korbin and N. Rogowin, Director and Associate Director of the Fiber Research Institute in Mitishchi near Moscow. The U. S. S. R. produces a yearly cotton crop of about 2.4 million tons, mainly in the Middle Asian States of Azerbejstan, Kagakstan, and Usbekstan and possesses the largest wood supply in the world. As a consequence there is considerable interest in fundamental and applied research on cellulose and related carbohydrates and on other chemical constituents of wood, such as rosin, terpenes, tanning agents, and lignin. Kargin's concept of gradual transition from "crystalline" to "amorphous" is experimentally pursued in a similar manner as the "lateral order distribution" in this country.

Much electron microscope work is carried out with cotton fibers in various stages of dissolution and modification at the Tashkent Institute. Cyanoethylation, chlorophenylation, and grafting of acrylic acid derivatives are being studied to modify the textile properties of rayon and cotton. A special team in Mitishchi works on tire yarns and cords using higher DP cellulose, zinc sulfate, and various chemical and physical modifiers. The spinning of triacetate directly from the acetylation mixture is studied in a pilot unit

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and the properties of the resulting fibers are now being tested in a market research effort. Altogether, it is estimated that some 15 scientists of professional rank and about 400 research fellows and assistants are engaged in basic and applied work in the field of cellulose and its derivatives.

Leningrad

The Institute of Macromolecular Chemistry (Birzevoi Prospect 6) is directed by Prof. Danilov and Prof. A. A. Korotkov, one of the old timers of synthetic rubber chemistry and technology, who was a collaborator of Lebedev for many years and is still personally engaged in laboratory work on the Li-alkyl catalyzed polymerization of vinyl compounds and dienes. The Institute is housed in a building of some 150,000 sq. ft. floor space, and consists of 10 divisions, each directed by a head of professional rank. It employs about 80 Ph. D. research fellows and some 250 helpers and assistants. The work extends over all phases of polymer chemistry: synthesis of new monomers, polymerization under all kinds of conditions, characterization of the resulting polymers in solution, and examination of their behavior in the solid state.

The organic synthesis division is directed by Prof. M. M. Koton who, with some 20 coworkers, synthesizes complicated and interesting vinyl derivatives. All fluorinated, chlorinated, and methylated styrenes were prepared and their polymerization and copolymerization characteristics were studied. Higher vinyl aromatics were added to them together with a series of substituted phenyl- and biphenyl-methacrylates (J. Org. Chem. *26*, 475; 1956. Ibid. *27*, 2142; 1957. Dokl. Akad. Nauk *115*, 97; 1957).

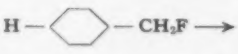
Also of great interest is the synthesis and examination of such compounds as tetravinyl tin, trivinyl phenyl tin, divinyl diphenyl tin, and the corresponding allyl derivatives, which polymerize and copolymerize with the formation of high softening temperature products.

An unusual case of polymerization was encountered in the behavior of trifluoro allyl alcohol, which undergoes self-polymerization according to

$$CF_2 = CF - CH_2 - OH \longrightarrow$$

$$-[CH_2 - CHF - CH_2 - O]-_n$$

and with benzyfluoride which shows a tendency to polymerize by dehydrofluorination



Prof. A. Wansched is also interested in essentially synthetic work, concentrating on phenol-formaldehyde condensates, which are sulfonated and converted to ion exchange resins. The condensation of phenol with acetic acid leads to para-phenol-acetic acid which undergoes self-condensation to a linear polymer. This material can be cross-linked with formaldehyde and after sulfonation gives an interesting species of ion exchange system. There are also attempts under way to sulfonate lignins and produce a useful ion exchanger.

Prof. S. E. Bresler is in charge of physico-chemical studies of high polymers and, with the able assistance of Dr. Fraenkel, Jr., is operating a number of instruments of outstanding character: a very powerful ultracentrifuge; an electrophoresis and diffusion apparatus of high sensitivity; and an excellent paramagnetic resonance instrument with which one can detect free radicals in solutions in concentrations down to 10^{-13} moles per liter. The latter is used to study the decomposition of peroxides and other labile organic molecules at high temperatures which are molded into high melting plastics and, therefore, experience a particularly strong cage effect. Together with Prof. V. N. Tsvetkov, who is in charge of an excellent collection of osmometers, viscometers, and light scattering instruments, the molecular weight distribution of Li-butyl catalyzed polymethyl methacrylate was investigated and was found to be extremely sharp, apparently even sharper than that of the living polymers of M. Szwarc and of the photo-initiated polystyrenes of B. H. Zimm.

Prof. A. A. Korotkov, co-director of the Institute of Macromolecular Chemistry in Leningrad

Prof. Bresler has a group of his collaborators working on proteins and polypeptides which are purified by ion exchange membranes, which contain COOH and NH_2 groups in precisely prearranged distances. These membranes act like molecular sieves and permit a rapid and perfect purification of materials such as insulin and streptomycin.

Birefringence apparatus

Prof. V. N. Tsvetkov operates a very precise and sensitive flow birefringence apparatus in which the outer cylinder rotates and the inner is stationary. Very high rates of shear are obtained with this instrument and the relaxation of flow birefringence was measured for many polymers in different solvents over a wide range of temperatures. Another special feature in Prof. Tsvetkov's equipment is the use of a polarization interferometer to measure concentration gradients in a diffusion cell (Dokl. Akad. Nauk *88*, 49; 1953. Ibid. *96*, 323; 1954. J. Pol. Sci. 1958 in press). One very interesting result is the unexpected fact that in very dilute polymer solutions the diffusion coefficient becomes independent of concentration and tends to a constant value as concentration approaches zero. This new method is now also introduced into the ultra-

(*To page* 181)

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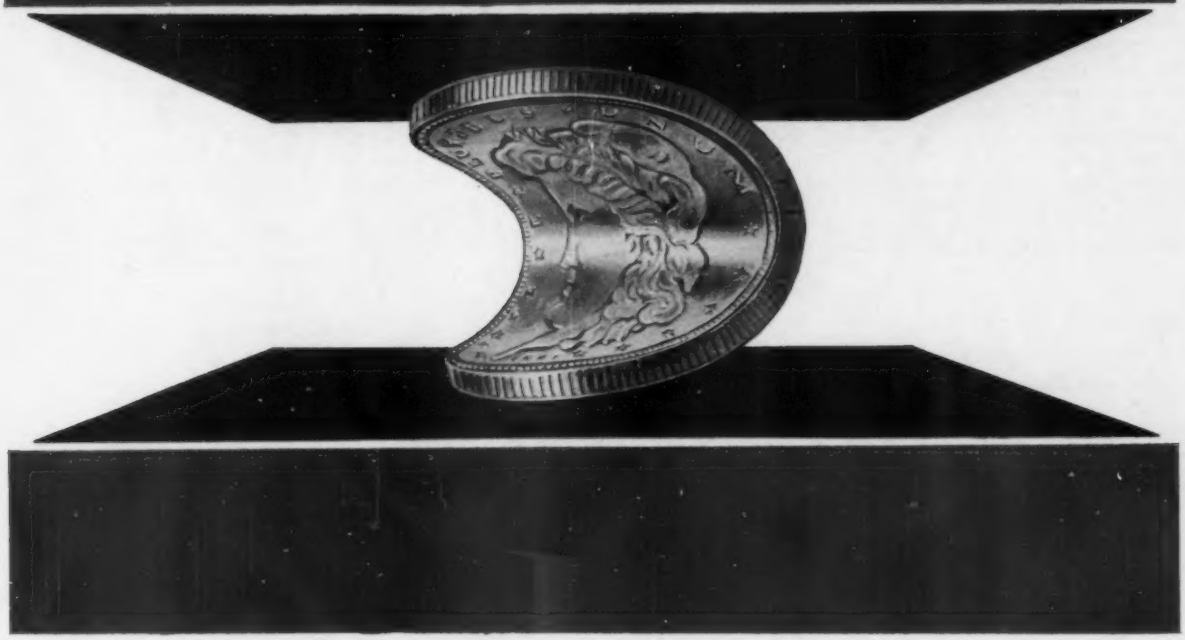

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Creep and stress-rupture behavior of rigid PVC pipe—Part 1

*By J. H. Faupel**

Results of work directed at the establishment of design principles for plastics under various conditions of static stress and time are presented. It is shown for rigid polyvinyl chloride (PVC) at 73° F. that creep and stress-rupture behavior can be predicted from stress-relaxation data. Various states of stress were obtained by subjecting tubes to various combinations of tension and internal pressure.

The theoretical principles and some of the experimental results are given in Part 1 of this article; further results and the interpretation of the whole will appear next month in Part 2.

This article deals with the static behavior of rigid PVC pipe. While the creep behavior of plastics subjected to simple states of stress can now be predicted on the basis of one-day stress-relaxation tests, there is little information available on stress-rupture of plastics under combined stresses. The present work has been directed towards the development of a correlation between a) uniaxial and multiaxial states of stress when the major variable is time and b) correlation between short- and long-time tests. As will be shown, there is also a correlation between stress-relaxation and stress-rupture for PVC.

Stress analysis

Fundamental relations: Linear viscoelastic theory and its application to static stress analysis procedures have received considerable attention and the theory is now highly developed (1-4).[1] The viscoelastic problem can be solved by setting up the equivalent elastic problem with viscoelastic terms substituted for the elastic constants in the strain equations. Determination of the viscoelastic quantities is accomplished through stress-relaxation measurements, and data are analyzed by various theories involving spring-dashpot models. A common method is to analyze creep on the basis of an infinite number of Voigt units in series with a Maxwell unit, and relaxation behavior on the basis of an infinite number of Maxwell units in parallel (1). The fact that these two systems of elements are equivalent has led to the prediction of creep from relaxation data and *vice versa*. In many cases relaxation data are more convenient to obtain, thus the utility of the method. Some of the highlights of the linear theory are presented below:

The basic differential equation for a Maxwell unit is

$$\frac{d\epsilon}{dT} = \frac{1}{E}\frac{d\sigma}{dT} + \frac{\sigma}{\eta} \qquad \text{Eq. 1}^2$$

which integrates to

$$\sigma = \sigma_0 e^{-\frac{\tau}{\tau}} + Ee^{-\frac{\tau}{\tau}}\int_0^\tau e^{\frac{\tau}{\tau}}\frac{d\epsilon}{dT}\,dT \qquad \text{Eq. 2}$$

For constant strain (stress-relaxation), $d\epsilon/dT$ is zero, thus the following relation pertains:

$$\sigma = \sigma_0 e^{-\frac{\tau}{\tau}} \qquad \text{Eq. 3}$$

For a single nondegenerate Voigt element the basic differential equation is

$$\sigma = \eta\frac{d\epsilon}{dT} + E\epsilon \qquad \text{Eq. 4}$$

which integrates to

$$\epsilon = \epsilon_0 e^{-\frac{\tau}{\tau}} + \frac{1}{\eta}e^{-\frac{\tau}{\tau}}\int_0^\tau e^{\frac{\tau}{\tau}}\sigma\,T dT \qquad \text{Eq. 5}$$

Since the instantaneous deformation ϵ_0 at constant stress σ is zero, Eq. 5 reduces to

$$\epsilon = \frac{\sigma}{E}\left(1 - e^{-\frac{\tau}{\tau}}\right) \qquad \text{Eq. 6}$$

which represents part of the deformation. The additional deformation is found by noting that the model consists of one nondegenerate Voigt element and two degenerate elements. When the degenerate element consists of a spring then

$$\epsilon = \frac{\sigma}{E_0} \qquad \text{Eq. 7}$$

and when the degenerate element consists of a dashpot,

$$\epsilon = \frac{\sigma T}{\eta} \qquad \text{Eq. 8}$$

Therefore, the total deformation is

$$\epsilon = \frac{\sigma}{E_0} + \frac{\sigma}{E}\left(1 - e^{-\frac{\tau}{\tau}}\right) + \frac{\sigma T}{\eta} \qquad \text{Eq. 9}$$

or, excluding permanent set,

$$\epsilon = \frac{\sigma}{E_0} + \frac{\sigma}{E}\left(1 - e^{-\frac{\tau}{\tau}}\right) \qquad \text{Eq. 10}$$

The term τ in Eq. 3 and 10 has different significance, since in one equation the term is based on a concept of relaxation and in the other on the basis of creep; thus, in the literature, these are respectively known as a "relaxation time" and a "retardation time," leading in the case of infinite ele-

* Engineering Research Laboratory—Engineering Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

[1] Numbers in parentheses link to references at end of article, p. 188.

[2] For definition of symbols, see p. 125.

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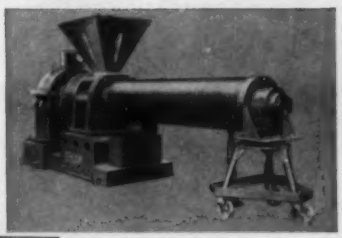

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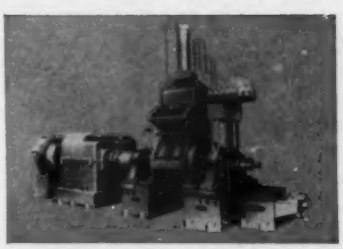

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Table I: Typical properties of rigid polyvinyl chloride

Density, lb./cu. ft.	86.00
Coeff. of linear expansion, in./(in.) (°F.) × 10^5	9.36
Coeff. of thermal conductivity, B.t.u./(sq. ft.) (hr.) (°F./ft.)	0.105
Dielectric strength, v./mil	1413
Specific heat, B.t.u./(lb.) (° F.)	0.25
Modulus of elasticity, p.s.i.	450,000
Tensile strength, p.s.i.	
—40° F.	12,200
32° F.	8,900
78° F.	6,400
140° F.	4,100
Yield strength, (73° F.), p.s.i.	4,500
Elongation at ultimate tensile strength, %	3-5[a]

Maximum operating pressure for pipe with plain ends[b]

Pipe size	75° F. Sch. 40	75° F. Sch. 80	150° F. Sch. 40	150° F. Sch. 80
in.				
½	410	575	220	310
¾	335	470	180	250
1	310	435	170	235
1¼	255	360	140	195
1½	230	325	125	175
2	195	280	110	150
3	185	260	100	140
4	155	225	85	120
6	125	195	65	110

[a] The fracture elongation which may be 50-150% has little design significance.
[b] As recommended by the plastics industry and tabulated in sales literature.

ments in the deformation model to complex quantities known as relaxation and retardation functions. Through such a theory, MacLeod (4) arrived at a correlation between creep and relaxation which indicated that

$$\epsilon = \epsilon_0 \frac{\sin m\pi}{m\pi}\left(\frac{T}{b}\right)^m \qquad \text{Eq. 11}$$

for times greater than one hour, where m and b are material parameters determined from the following equation defining the experimental stress-relaxation data when plotted on logarithmic coordinates (and also approximately on semi-log coordinates):

$$\frac{\sigma}{\sigma_0} = \left(\frac{T}{b}\right)^{-m} \qquad \text{Eq. 12}$$

For design the above theory can be simplified somewhat since the trigonometric term in Eq. 11 approaches a value of unity for values of m below about 0.2. Therefore, for the many plastics which have m values below 0.2

$$\frac{\epsilon}{\epsilon_0} = \left(\frac{T}{b}\right)^m \qquad \text{Eq. 13}$$

Equating Eqs. 12 and 13 to relate creep and stress relaxation gives

$$\left(\frac{\epsilon}{\epsilon_0}\right)_{\text{creep}} = \left(\frac{\sigma_0}{\sigma}\right)_{\text{stress relaxation}} \qquad \text{Eq. 14}$$

Thus, with σ_0/σ from relaxation tests,

$$\epsilon = \epsilon_0\left(\frac{\sigma_0}{\sigma}\right) \qquad \text{Eq. 15}$$

If the ordinary elastic modulus is known, ϵ_0, the initial strain can be replaced by the quantity σ_0/E_0 and Eq. 15 becomes

$$\epsilon = \frac{\sigma_0}{E_0}\left(\frac{\sigma_0}{\sigma}\right) \qquad \text{Eq. 16}$$

Therefore, Eqs. 15 or 16 can be used for design calculations. In Eq. 16, the term $\sigma E_0/\sigma_0$ is a "time-modified" modulus; thus

$$\frac{1}{E} = \frac{1}{E_0}\left(\frac{\sigma_0}{\sigma}\right) \qquad \text{Eq. 17}$$

or

$$\frac{E}{E_0} = \frac{\sigma}{\sigma_0} \qquad \text{Eq. 18}$$

A typical plot of E/E_0 will be presented in Part II of this article (Fig. 8). Thus for analyzing the viscoelastic problem the equivalent elastic solution is set down and E substituted for E_0 regardless of whether E_0 appears as a modulus or a compliance. Where Poisson's ratio appears in the equivalent elastic problem it is replaced by

$$\mu = \frac{3B-E}{6B} \qquad \text{Eq. 19}$$

which results from the fact that the bulk modulus, B, remains essentially constant throughout deformation; E is the time-modified modulus. A detailed design example illustrating the theory is given in the last section of the article; however, to emphasize the main points, two typical design problems, with solutions, are given below:

Beam fixed at both ends and center loaded:

Elastic solution: $\delta_{max.} = \dfrac{WL^3}{192E_0I}$

Approximate viscoelastic solution:

$$\delta_{max.} = \frac{WL^3}{192EI}$$

Exact viscoelastic solution (4):

$$\delta_{max.} = \frac{WL^3}{192I}\left[\frac{1}{E_0}\frac{\sin m\pi}{m\pi}\left(\frac{T}{b}\right)^m\right]$$

Circular plate freely supported at rim and uniformly loaded:

Elastic solution:

$$\delta_{max.} = \frac{3Wa^2}{16\pi E_0 t^3}[(1-\mu)(5+\mu)]$$

Approximate viscoelastic solution:

$$\delta_{max.} = \frac{Wa^2}{32\pi EBt^3}[(3B+E)(33B-E)]$$

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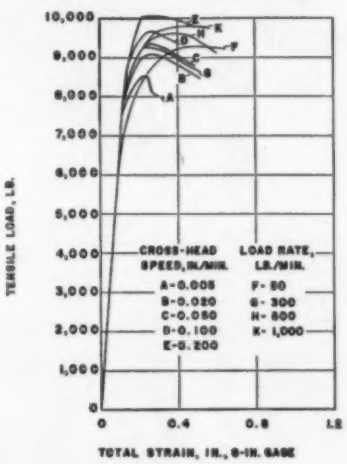

Fig. 1: Results of tension tests at 73° F. on 2-in. Schedule 80 PVC pipe

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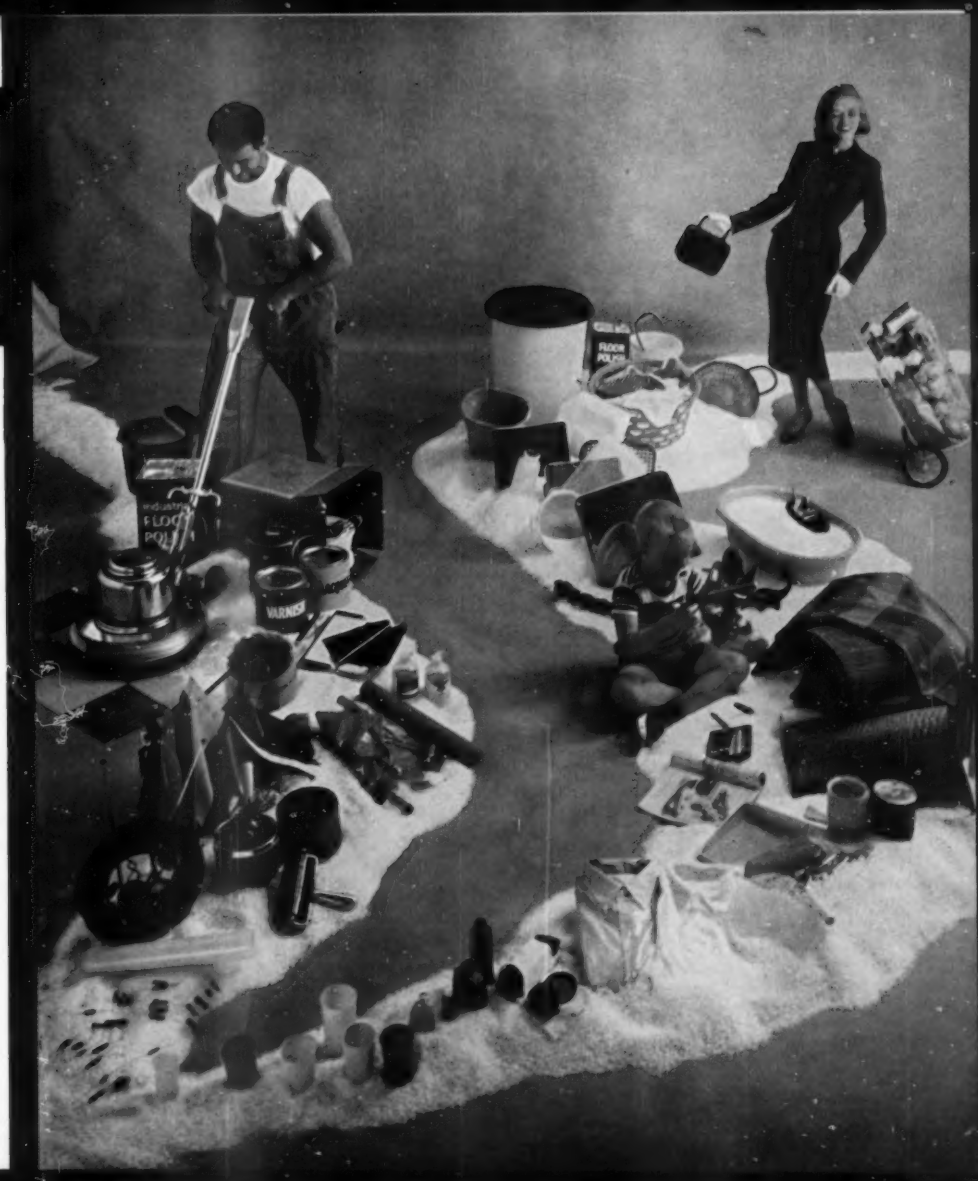

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Exact viscoelastic solution: $\delta_{max.} = \frac{Wa^2}{32\pi Bt^3}\left[\frac{1}{E_0}\frac{\sin m\pi}{m\pi}\left(\frac{T}{b}\right)^m\right]\left[3B+E_0\left(\frac{T}{b}\right)^{-m}\right]\times\left[3B-E_0\left(\frac{T}{b}\right)^{-m}\right]$

In the above equations, E is the time modified modulus obtained from stress-relaxation data. For example, if $\delta_{max.}$ at 100 hr. were desired for a beam of PVC, then, from Fig. 8, E/E_0 for 100 hr. (tension) is 0.68; therefore, E is 0.68 (450,000) = 306,000 p.s.i., which is the time-dependent modulus value used in making the calculation.

Consideration of anisotropy: Before considering the equations involved in multiaxial-loading problems, it is necessary to introduce the factor of anisotropy of properties.

At least two types of anisotropy of physical properties exist; first, there are differences that can be reflected in ordinary stress-strain curves where different moduli, strengths, and ductilities can be observed depending on the direction of testing; second, there are differences that are reflected in creep and stress-rupture behavior where time is a factor. Thus, in any analysis of the stress-strain behavior of a plastic material, it is necessary to distinguish between continuously increasing load at a steady rate, on the one hand, and creep on the other, where load is quickly applied and strains are a function of the time the load is held on the material; for continuously increasing loading the material parameters appearing in the equations will be different from the parameters characterizing creep or stress-rupture. Thus, a correct analysis of multiaxial loading problems requires the proper assignment of physical constants in the various stress-strain equations.

Definitions of symbols used in equations

- B = bulk modulus, p.s.i.
- E = modulus, p.s.i.
- E_0 = instantaneous modulus, p.s.i.
- I = moment of inertia, in.^{4}
- L = length, in.
- M = moment, in.-lb.
- T = time
- W = total load, lb.
- X, Y, Z = constants, see text.
- a = radius of circular plate, in.
- b = relaxation parameter, hr.
- c = distance from neutral axis to furthest stressed fiber in beam, in.
- d_i = inside diameter of pipe, in.
- e = base of natural logarithm
- m = relaxation parameter
- p = internal pressure, p.s.i.
- p_b = bursting pressure of pipe, p.s.i.
- t = thickness, in.
- $\alpha = \sigma_{02}/\sigma_{01}$
- $\beta = \sigma_{03}/\sigma_{01}$
- δ = deflection, in.
- ε = strain, in./in.
- $\varepsilon_1, \varepsilon_2, \varepsilon_3$ = principal strains, in./in.
- $\varepsilon_{01}, \varepsilon_{02}, \varepsilon_{03}$ = particular strains, in./in., see text
- ε_0 = initial elastic strain, in./in.
- η = viscosity
- μ = Poisson's ratio
- π = constant, 3.1416
- σ = stress, p.s.i.
- $\bar{\sigma}$ = equivalent stress, p.s.i.
- $\sigma_1, \sigma_2, \sigma_3$ = principal stresses, p.s.i.
- $\sigma_{01}, \sigma_{02}, \sigma_{03}$ = particular test stresses
- σ_0 = initial tensile stress, p.s.i.
- $\sigma_h, \sigma_r, \sigma_z$ = principal stresses in pipe (hoop, radial, longitudinal) p.s.i.
- σ_u = ultimate tensile strength, p.s.i.
- τ = relaxation time

Multiaxial loading: In the general anisotropic three-dimensional case, the values of the principal elastic strains can be expressed by the following equations:

$$\epsilon_1 = \frac{1}{E_1}[\sigma_1 - \mu_1(\sigma_2 + \sigma_3)] \quad \text{Eq. 20}$$

$$\epsilon_2 = \frac{1}{E_2}[\sigma_2 - \mu_2(\sigma_1 + \sigma_3)] \quad \text{Eq. 21}$$

$$\epsilon_3 = \frac{1}{E_3}[\sigma_3 - \mu_3(\sigma_1 + \sigma_2)] \quad \text{Eq. 22}$$

where the subscripts 1, 2, and 3 indicate the principal directions. For use beyond the elastic limit in ordinary loading the various E-values would be replaced by the appropriate secant moduli, and μ would equal 0.5. For use in viscoelastic analyses, where the load is quickly applied and strains are a function of time, E and μ terms are replaced with the appropriate "time-modified" values. In MacLeod's "exact" theory any term $1/E_0$ is replaced by the viscoelastic quantity $(1/E_0)$ (sin $m\pi/m\pi$) $(T/b)^m$ and any term E_0 is replaced by the quantity E_0 $(T/b)^m$. Poisson's ratio, μ, is replaced by the quantity given in Eq. 19. To completely characterize a multiaxial loading situation, it is necessary to make tests in the loading directions. For ordinary continuous loading stress-strain curves are obtained at rates comparable to the com-

Table II: Results of static burst tests on 2-in. rigid polyvinyl chloride pipe

	Ultimate strength			Burst test — method of this article		Calculated burst pressure, p.s.i.			
Sch. No.	ASTM short-time test	Rapid test	Burst pressure, ASTM method	Time to burst	Burst pressure	Theory of Eq. 39	Deviation from exp. results	Theory of Eq. 41	Deviation from exp. results
	p.s.i.	p.s.i.	p.s.i.	min.	p.s.i.		%		%
80	6800	7750	1400	0.2	1880	1740	−7	1545	−18
"	"	"		1.5	1740	"	0	"	−11
"	"	"		5.1	1700	"	+2	"	− 9
"	"	"		7.0	1700	"	+2	"	− 9
"	"	"		8.0	1720	"	+1	"	−10
40	"	"		2.0	1100	1155	+5	1060	− 4

bined-stress load rates, and for creep, stress-relaxation measurements are made.

Sometimes, for example in a pipe, it is not convenient to measure the radial properties; in this case, it may be assumed that the radial and transverse behaviors are identical.

Development of an "equivalent stress" and a criterion of failure: Eqs. 20-22, together with stress-relaxation data required to determine the "time-modified" moduli values, can be used in making viscoelastic strain (creep) calculations for a body subjected to combined loading. A method will now be shown for expressing the effect of combined stresses in a material by a tensile value called the "equivalent stress." Through such a stress one may, for example, compare the behavior of tubes of various size and schedule number on a common basis. This general relationship also leads to a criterion of failure and enables one to calculate "failure" stresses for various types of loading from tensile test values. For example, in ordinary loading, the burst pressure of a tube can be predicted from the tensile strength of the material and in creep, the pressure corresponding to a tensile stress at, say, 2% tensile creep, can be predicted. Details of the analysis for ordinary combined loading of isotropic material may be found in the works of Nadai (5). The final result of the analysis relates an "equivalent" tensile stress, $\bar{\sigma}$, to the three principal stresses in combined loading as follows:

$$2(\bar{\sigma})^2 = (\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2 \qquad \text{Eq. 23}$$

where $\bar{\sigma}$ is a tensile test value (i.e., the yield strength if yielding under combined stresses is under consideration. If the material is anisotropic, then Eq. 23 is modified as follows:

$$2(\bar{\sigma})^2 = X(\sigma_1 - \sigma_2)^2 + Y(\sigma_2 - \sigma_3)^2 + Z(\sigma_3 - \sigma_1)^2 \qquad \text{Eq. 24}$$

where X, Y and Z are parameters defining the degree of anisotropy in the material. These constants may be evaluated by successively considering two of the principal stresses to be zero; when this is done, it is found that

$$X = 2\left(\frac{\bar{\sigma}}{\sigma_{01}}\right)^2 - \left(\frac{\bar{\sigma}}{\sigma_{02}}\right)^2\left[\beta^2 - \left(\frac{\alpha}{\beta}\right)^2 + 1\right] \qquad \text{Eq. 25}$$

$$Y = 2\left(\frac{\bar{\sigma}}{\sigma_{02}}\right)^2 - 2\left(\frac{\bar{\sigma}}{\sigma_{01}}\right)^2 + \left(\frac{\bar{\sigma}}{\sigma_{03}}\right)^2\left[\beta^2 - \left(\frac{\alpha}{\beta}\right)^2 + 1\right] \qquad \text{Eq. 26}$$

$$Z = \left(\frac{\bar{\sigma}}{\sigma_{03}}\right)^2\left[\beta^2 - \left(\frac{\alpha}{\beta}\right)^2 + 1\right] \qquad \text{Eq. 27}$$

where $\alpha = \frac{\sigma_{02}}{\sigma_{01}}$, $\beta = \frac{\sigma_{03}}{\sigma_{01}}$ and σ_{01}, σ_{02} and σ_{03} are particular stress values; i.e., σ_{01} might be the tensile-yield strength in the σ_1 direction. In the pipe problem the radial and hoop properties may be considered equal; thus, β equals unity and if we choose the longitudinal tensile properties as the basis of correlation

$$X = \alpha^4 \qquad \text{Eq. 28}$$

$$Y = 2 - \alpha^4 \qquad \text{Eq. 29}$$

$$Z = \alpha^2(2 - \alpha^2) \qquad \text{Eq. 30}$$

Consider a closed-end thin-wall pipe subjected to internal pressure, the pipe material being anisotropic. The maximum principal stresses in the pipe wall are

$$\sigma_1 = \frac{pd_i}{2t} \qquad \text{Eq. 31}$$

$$\sigma_2 = \frac{pd_i}{4t} \qquad \text{Eq. 32}$$

$$\sigma_3 = -p \qquad \text{Eq. 33}$$

Thus, from Eqs. 24, 28-33,

$$(\bar{\sigma})^2 = p^2\left\{\frac{\alpha^4}{8}\left(\frac{d_i}{2t}\right)^2 + \frac{2-\alpha^4}{2}\left[\left(\frac{d_i}{4t}\right)^2 + \frac{d_i}{2t} + 1\right] + \frac{\alpha^2(2-\alpha^2)}{2}\left[\left(\frac{d_i}{2t}\right)^2 + \frac{d_i}{t} + 1\right]\right\} \qquad \text{Eq. 34}$$

where $\bar{\sigma}$ is the correlation tensile test stress value in the σ_2 (longitudinal) direction and α is the anisotropy constant. In ordinary loading α would be determined from the usual stress-strain diagrams; for example, in Eq. 34 if the yield pressure were under consideration then α would be the ratio of the tensile yield strengths in the σ_2 and σ_1 directions; when applied to the analysis of a creep problem, $\bar{\sigma}$ would be the tensile stress corresponding to a particular tensile strain. For example, suppose in Eq. 34 the designation p represents the pressure that is associated with 1% creep in the σ_2 direction at 100 hours.

Then, $\bar{\sigma}$ would be the tensile stress necessary to produce 1% creep in 100 hr. in a tensile specimen cut in the σ_2 (longitudinal) direction of the pipe; α in this case would be the ratio of the stresses to produce 1% creep in 100 hr. in tensile specimens in the σ_2 and σ_1 directions. These quantities may be computed from stress-relaxation measurements. For example, for PVC, after 100

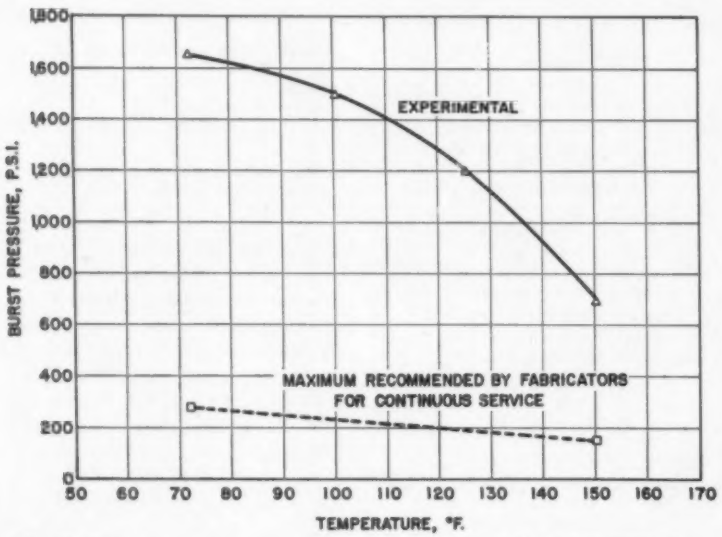

Fig. 2: Burst pressure versus temperature for 2-in. Schedule 80 PVC pipe

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hr. under load σ/σ_0 in the longitudinal direction (tension relaxation) is about 0.680 and in the hoop direction (pressure relaxation) about 0.765. Then from Eq. 15,

$$0.01 = \frac{\epsilon_{02}}{0.680}, \text{ or } \epsilon_{02} = 0.0068 \text{ in./in., and}$$

$$0.01 = \frac{\epsilon_{01}}{0.765}, \text{ or } \epsilon_{01} = 0.00765 \text{ in./in.}$$

Then, since stress equals strain $\times$ modulus, $\sigma_m = 450{,}000\ (0.0068) = 3{,}060$ p.s.i., and $\sigma_m = 450{,}000\ (0.00765) = 3{,}440$ p.s.i. Thus, from these calculations $\bar{\sigma} = 3{,}060$ p.s.i. and $a = 3060/3440 = 0.89$; these values would then be substituted into Eq. 34 to obtain the actual value of the pressure, p. For either type of loading, the theory has the advantage of relating some quantity, the pressure in a tube in this case, to a correlation tensile stress, $\bar{\sigma}$, for all tube sizes. Thus, in tube design work one can compare equivalent stresses, $\bar{\sigma}$, for various sizes of tubing subjected to various types of loading, on a common basis. If the material is isotropic, Eq. 34 reduces to

$$p = \frac{\bar{\sigma}}{\sqrt{\frac{3}{16}\left(\frac{d_i}{t}\right)^2 + \frac{3}{4}\left(\frac{d_i}{t}\right) + 1}} \quad \text{Eq. 35}$$

Stress-rupture problem: It was observed for PVC when stress for stress-rupture failure was plotted against time on a logarithmic scale a straight line was obtained. The implication is that stress relaxes with time in a stress-relaxation test of PVC, just as allowable stress diminishes with time in a stress-rupture test. On this basis the time parameters characterizing stress-relaxation appear to be the same as those characterizing stress-rupture and one might expect a correlation between the two.

When the short-time ultimate strength of polyvinyl chloride is used as the initial stress value on the stress-relaxation plot the relaxation line fits the experimental stress-rupture data quite well.

Thus, for stress-rupture of PVC Eq. 34 also suffices as a criterion of failure. In this case, $\bar{\sigma}$ represents the ultimate strength of the material obtained in a rapid test (6-10 sec.) in the σ_2 direction and a is determined as previously described. For tube design for materials that are not unduly anisotropic Eq. 35 could be used where $\bar{\sigma}$ would be the tensile stress rupture value at any particular time.

Procedure and results

Material tested: The tests described in this paper were performed on unplasticized polyvinyl chloride pipe, various properties of which are listed in Table I, p. 122.

Specimens and geometry: Three types of tests were conducted: ordinary tension tests, tests on pipe subjected to combinations of internal pressure and tension, and stress-relaxation tests in tension and on pipe under internal pressure. The tension-type tests were conducted on full-size 2-in. pipe. Pressure tests were conducted on 2-in. Schedule 40 and 2-in. Schedule 80 pipe.

Tension tests: Short-time tensile tests at 73° F. were performed on full-size pipe under A.S.T.M. standard conditions and also under conditions of varying load rates (50 to 4000 lb./min.) and machine cross-head speeds (0.005-1.0 in./min.); for these tests nearly identical elastic moduli were observed; the ultimate strengths increased as load rates or speeds increased. Strain data for the highest load rate and speed were obtained only for the initial portion of the elastic range; however, the load reached in these tests was nearly 11,000 lb. The results are shown in Fig. 1, p. 122, as normal stress-strain plots. It is recognized that true stress and true strain, being based on actual dimensions, are of a more fundamental nature and more accurately represent how materials deform. However, for the work reported here nominal stress and strain are used for several reasons: first, in design applications both nominal and true values are essentially equal and the small added accuracy resulting from the use of true values does not justify their use; secondly, interpretations are possible only if considerable quantities of strain data are recorded for each test—this is usually impractical and in some cases is impossible.

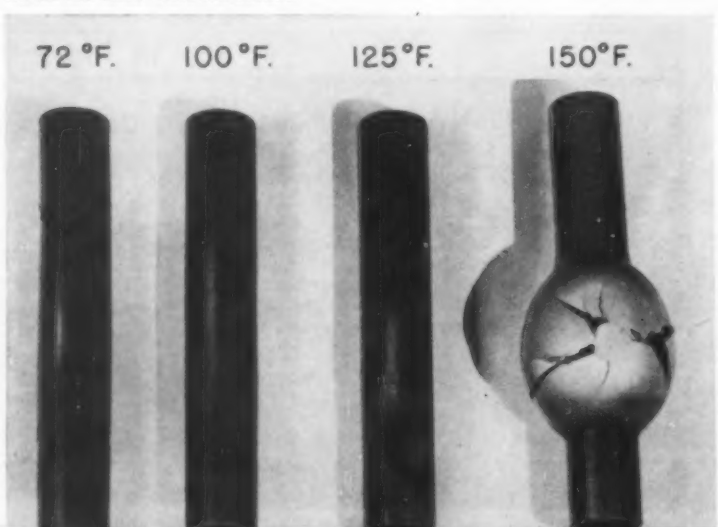
Short-time burst tests: Most of the internal-pressure tests were conducted using a filler-bar equipped with "O" ring seals and a pressure inlet. With this setup the longitudinal stress is zero and we have a test for pure internal pressure.

Several tests were also made in which the pressure did induce a longitudinal stress in the pipe wall. Testing was done both with nitrogen gas or water as pressurizing media, and no significant difference in bursting pressure was noted due to the pressure medium.

For comparison, room-temperature tests were also made in accordance with A.S.T.M. Specification D 1180-51T. In this test short cylinders are used and loading is done by a ram. Most of the tests conducted by the A.S.T.M.

(*To page* 188)

Fig. 3: Burst tests on 2-in. Schedule 80 polyvinyl chloride pipe, using water. Numerals along top show different temperatures at which the tests were conducted



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General

Guide to materials standards and specifications. Part 1—Government and national standards. S. P. Kaidanovsky. Materials in Design Eng. *47*, 96-100 (Mar. 1958). A discussion of the organizations that issue national standards and specifications is presented in relation to the function of the organization and the classification and coding of the specifications. Federal specifications and standards of the General Services Administration are developed by the Federal Supply Service. They are designated as Federal Specifications, Interim Federal Specifications, and Federal Standards. They cover all materials and supplies purchased by the civilian branches of the Government and by the military agencies when appropriate. Products covered and the method of developing the specifications and standards are described. Military specification and standard designations are given. Commercial standards are voluntary and are developed through cooperative action of producers, distributors, testing laboratories, and users; they are published by the Commodity Standards Division, Office of Technical Services, Department of Commerce. American Society for Testing Materials Standards comprise specifications, methods of testing, recommended practices, definition of terms, charts, and tables. The activities of the Society of Automotive Engineers and the American Standards Association are also described.

Developments in polyurethanes, unsaturated polyesters, polyvinyl chloride, and acrylonitrile copolymer blends, 1957. W. Cummings and R. L. Knapp. Plastics Tech. *4*, 241-44 (Mar. 1958). Developments in polyurethanes, unsaturated polyesters, polyvinyl chloride, and acrylonitrile copolymer blends during 1957 are reviewed. 77 references.

Man-made fibers weave glowing future. E. Schwarz. Chem. Week *82*, 93-115 (Mar. 8, 1958). Production figures and prediction for the future for rayon, nylon, acrylic, polyester, vinyl chloride, vinylidene chloride, Teflon, polyethylene, carbon, protein, glass, and ceramic fibers are discussed. Manufacturers, plant locations, tradenames, and types produced of each of these fibers are listed in tabular form.

Materials

Sandwich-panel facing materials. R. K. Humke. Prod. Eng. (Design ed.) *29*, 80-83 (Apr. 28, 1958). Facings frequently used in sandwich construction include wood, carbon steel, stainless steel, aluminum, copper, magnesium, plastics (especially the fiber-reinforced types), and some nonmetal inorganics such as asbestos cement board. Very thin metal sheets often provide strength sufficiently high to resist beam stresses. However, slight thermal buckling often produces a wavy surface. This can be corrected with a more rigid core. The thin sheets need secondary facing for impact loads so that the load will be distributed over the core area. Thermal coefficients of expansion of the two facings must be balanced to prevent distortion by unbalanced shrinking. Glass-reinforced polyesters, epoxies, phenolics, and silicones offer high strength-weight ratios for facings as well as corrosion resistance and good dielectric properties. Cores of foamed plastic such as urethanes and polystyrenes work well with laminated plastic faces because the lay-up process tightly locks facing to core. Non-reinforced thermoplastic sheet material is often post-formed and combined with foamed-in-place cores of urethanes, polystyrenes, and vinyls.

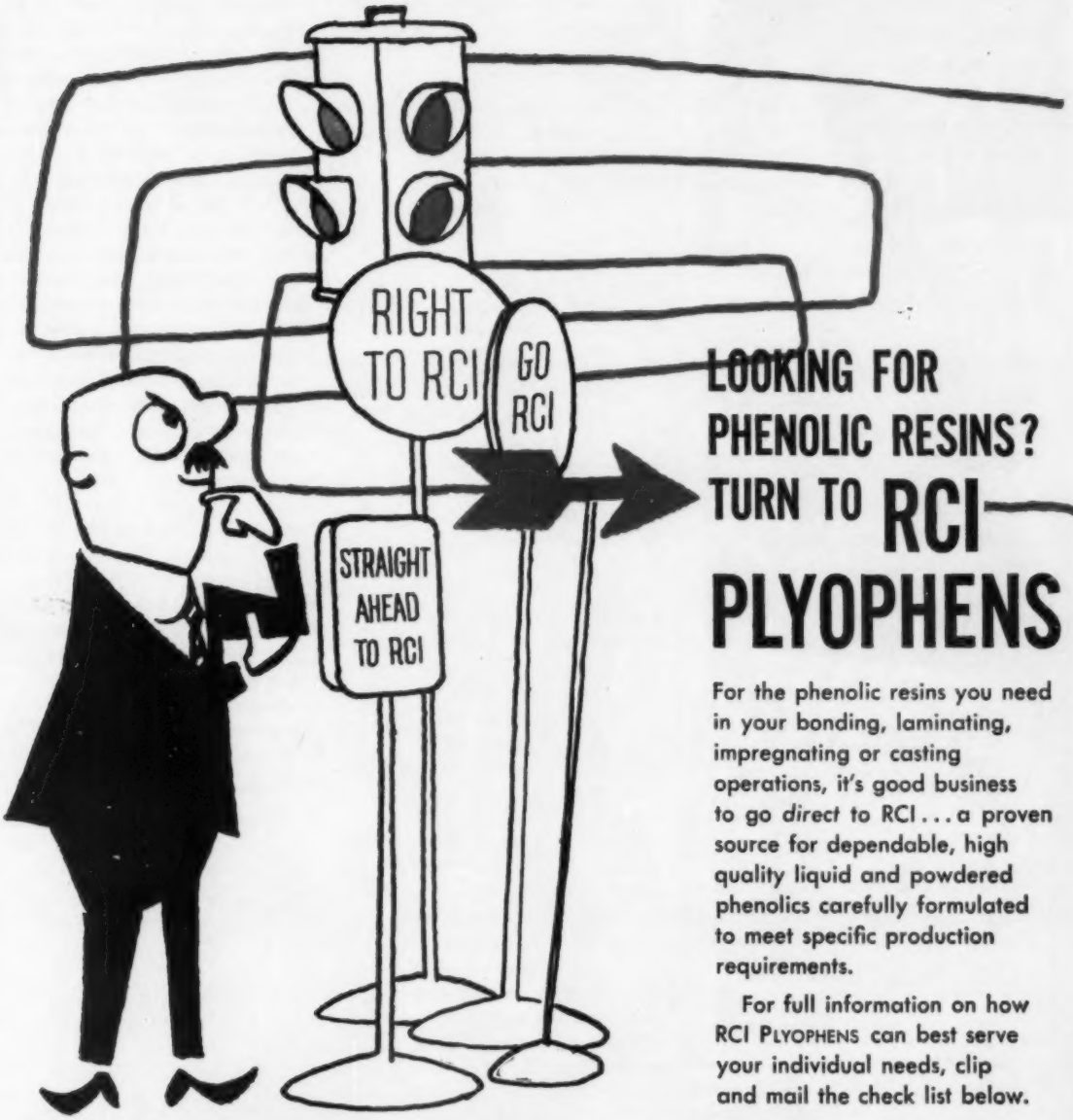
The influence of formulation on the processing of PVC compositions. R. Hammond. Plastics Inst. Trans. *26*, 49-68 (Jan. 1958). The effects of type of polymer, copolymer, plasticizer, and stabilizer on the processing properties of polyvinyl chloride molding compounds are reviewed.

Higher density polyethylenes. G. H. Sollenberger. SPE J. *14*, 23-24, 64 (Jan. 1958). The physical and chemical properties of the higher density polyethylenes, where reference is made to materials in the density range of 0.941-0.956, are reviewed. These properties and certain applications for these materials are compared, in general, with those of the conventional low density polyethylenes. Results reported in the literature are shown to vary considerably with minor variations in testing procedures. Suggestions are made for more uniform methods of tests, which would make data obtained from various sources more useful. A general review of properties and applications of the low, medium, and high density polyethylenes indicate that certain striking differences occur between these materials which will allow full commercial development of each type with a minimum of competition in applications.

Molding and fabricating

Importance of fabrication on the properties of silicone-glass laminates. E. C. Elliott and K. R. Hoffman. Plastics Tech. *4*, (Mar. 1958). Variations in laminate properties caused by washed versus unwashed glass fabric; tensile strength; catalyst concentration; pre-cure time and temperature; resin content; fabric orientation; molding method,

* Reg. U. S. Pat. Off.



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pressure, and temperature; post-cure time, and laminate thickness are reported.

Bladder molding forms smooth plastic laminates. J. A. Bagley and F. M. Partridge. Am. Machinist *102*, 102-103 (Apr. 7, 1958). New bonding techniques and new tool designs which make possible the molding of glass fiber laminates in shapes previously considered impractical are described.

Bonding of Teflon. E. R. Nelson, T. J. Kilduff, and A. A. Benderly. Ind. Eng. Chem. *50*, 329-30 (Mar. 1958). A new process is described for rendering Teflon bondable with ordinary adhesives. This process involves the immersion of the polymer in a solution of sodium-naphthalene complex in tetrahydrofuran. The bath is stable for periods in excess of two months. The surface of the polymer turns grayish brown in color and the attack, extending to a depth of less than 4×10^{-5} in., had no significant effect on the electrical properties of the polymer. When the treated surfaces were bonded to metal or to themselves with an epoxy resin, they yielded bond strengths in the range 1100 to 2000 p.s.i. in tension or shear, and bondability was virtually independent of treatment times from 0.5 to 24 hours. The process uses a stable bath and requires no refrigeration or exhaust systems. It is, therefore, particularly suited to small-scale or intermittent operations.

Applications

Surveillance of cinematograph record film during storage. G. L. Hutchinson, L. Ellis, and S. A. Ashmore. J. Appl. Chem. *8*, 24-34 (Jan. 1958). Many problems are involved in the storage of cellulose nitrate plastic photographic film containing records and historical information. Most severe of these problems are the sudden complete deterioration of the photographic image and the continuous threat of spontaneous combustion. Because of the large quantities of film usually involved and certain economic factors, it has been necessary to withhold duplication of these films until the useful storage life is nearly ended. Films were visually checked for deterioration about once every two years, and in many cases valuable records were permanently lost due to sudden destruction of the image between observation periods. Preliminary investigations indicated that the silver halide image disappeared before any visible effect of deterioration of the cellulose nitrate occurred, and long before the danger of spontaneous combustion. Chemical tests showed the gelatin emulsion to be acting as a stabilizer, against degradation of the cellulose nitrate, while undergoing profound chemical and physical changes which destroyed the image.

Properties of phenolic, epoxy and vinyl coatings. Materials in Design Eng. *47*, 161, 163 (Apr. 1958). The properties of plastic coatings are presented in tabular form. The outstanding characteristics, physical properties, color and gloss, weathering properties, chemical resistance.

Properties

Arc resistance of epoxies. J. Delmonte. Plastics Tech. *4*, 228-30 (Mar. 1958). The effects of various fillers on the arc resistance of epoxy plastics are reported.

Effects of radiation on plastic packaging films. H. G. LeClair and W. H. Cobbs, Jr., Ind. Eng. Chem. *50*, 323-26 (Mar. 1958). In general the physical properties of these polymers are degraded with increasing radiation exposure, regardless of whether or not the polymer is cross-linked. The amount of such degradation at any given exposure level depends markedly on the structure of the polymer. Polymers which contained an aromatic ring, such as polystyrene and Mylar polyester film, are least affected by irradiation. This is consistent with the results reported by other investigators, showing that the aromatic ring has a stabilizing effect on organic polymers exposed to high energy radiation. On the other hand the cellulosic films are the most seriously degraded at all exposure levels. The polyethylene, as shown by solubility measurements, is cross-linked by irradia-

tion. At the same time it is unique in showing the sharply increased impact strength; all the other properties are degraded with increasing exposure at room temperature.

Studies on straining of high polymer solids. K. Ito. J. Polymer Sci. *27*, 419-31 (Jan. 1958). Straining of epoxy and polyvinyl chloride plastics in compression was investigated. The straining of network polymers is due solely to intramolecular micro-Brownian motion, named "deformation strain" and is not true plastic strain, even though strain may be frozen by secondary bonding forces at room temperature. Inter-molecular macro - Brownian motion, named "flow strain," is further added for the straining of linear polymers. The mutual relations between flow strain and deformation strain on rigid PVC are examined under various working conditions, such as working and annealing temperature, magnitude of worked strain, rate of strain, etc. The plastic working ability of high polymer solids is discussed in relation to working temperature.

Testing

Measuring the abrasion resistance of plastic lenses for sunglasses. P. M. Kamath and H. O. Buzzell. Plastics Tech. *4*, 132-36, 152 (Feb. 1958). An abrasion testing machine based on a flannel tape in which an abrasive powder is entrained is described. The abrasion resistance of coatings for plastics sunglass lenses were evaluated by this machine.

Detection of wood flour in cured phenolic moldings. I. Arendt and H. J. Schenck. Kunststoffe *48*, German Plastics Digest Section, p. 6 (Jan. 1958). Lignin in phenolic plastics is detected by hydrolysis with caustic soda and chromatographic analysis of the solution. (In English).

The ultracentrifuge as an instrument for testing adhesion. R. L. Patrick, W. A. Vaughan, and C. M. Doede. J. Polymer Sci. *28*, 11-16 (Feb. 1958). A technique was developed which allows the determination of essentially pure tensile strengths of single interface adhesive samples. Utilizing a suitably modified ultracentrifuge, model adhesive systems were ruptured in an attempt to obtain relative strengths of adhesive bonds in the interface.

Publishers' addresses

American Machinist: McGraw-Hill Publishing Co., Inc., 330 W. 42 St., New York 36, N. Y.

Chemical Week: McGraw-Hill Publishing Co., Inc., 330 W. 42 St., New York 36, N. Y.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Journal of Applied Chemistry: Society of Chemical Industry, 56 Victoria St., London S.W. 1, England.

Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.

Kunststoffe: Karl Hanser Verlag, Leonard-Eck-Strasse 7, Munich 27, Germany.

Materials in Design Engineering: Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

Plastics Institute Trans.: The Plastics Institute, 6 Mandeville Place, London, W. 1, England.

Plastics Technology: Bill Brothers Publishing Corp., 386 Fourth Ave., New York 16, N. Y.

Product Engineering: McGraw-Hill Publishing Co., Inc., 330 W. 42 St., New York 36, N. Y.

SPE Journal: Society of Plastics Engineers, Inc., 513 Security Bank Bldg., Athens, Ohio.

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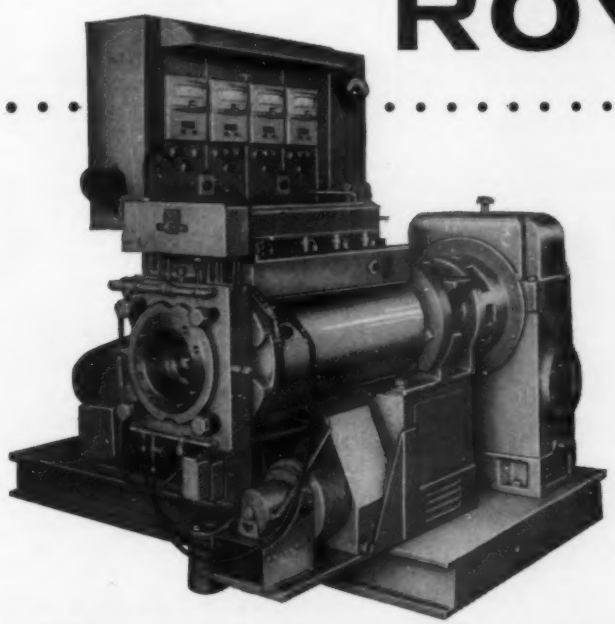

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U.S. Plastics Patents

Copies of these patents are available from the U.S. Patent Office, Washington, D.C., at 25¢ each.

Resins. J. M. Witzel (to General Electric). U. S. 2,825,712, Mar. 4. Modified aromatic hydrocarbon-aldehyde resins.

Resins. M. T. Harvey and P. L. Rosamilia (to Harvel). U. S. 2,825,-713, Mar. 4. Amine-modified acetone-formaldehyde resin.

Resins. S. Melamed (to Rohm & Haas). U. S. 2,825,714, Mar. 4. Derivatives of linear polymeric amines.

Polymers. G. F. D'Alelio (to Koppers). U. S. 2,825,715-6, Mar. 4. Polymers of N-(amino-1,2,4-triazolyl) amides of alkenyl-1,2-dicic acids.

Copolymers. E. P. Cashman, E. J. Corcoran, and R. M. Dean (to Esso Research). U. S. 2,825,717, Mar. 4. Dialkyl fumarate-vinyl acetate copolymers.

Copolymerization. K. Herrle, H. Fikentscher, and H. P. Siebel (to Badische-Anilin). U. S. 2,825,719, Mar. 4. Copolymerization of vinyl ethers.

Polymers. J. P. Hogan and R. L. Banks (to Phillips Petroleum). U. S. 2,825,721, Mar. 4. Production of olefin polymers.

Polymerization. N. D. Lee (to Distillers). U. S. 2,825,722, Mar. 4. Polymerization of alpha-chloroacrylonitrile.

Polyethylene. A. Ballauf, F. Munz, and O. Bayer (to Farbenfabriken Bayer). U. S. 2,825,723, Mar. 4. Derivatives of polyethylene.

Resins. G. I. Keim (to Hercules). U. S. 2,826,500, Mar. 11. Cationic-modified urea-resins.

Resins. M. V. Shelanski and M. W. Winicov (to West Laboratories). U. S. 2,826,528, Mar. 11. Halide polyalkyl acrylic resins.

Molding composition. E. P. Wenzelberger (to Commonwealth Engineering). U. S. 2,826,557, Mar. 11. Dextran derivatives.

Solution. H. Binder (to Rottweiler Kunstseid-fabrik). U. S. 2,826,558, Mar. 11. Perchloric acid solution of polyacrylonitrile.

Resin. I. H. Updegraff and N. R. Segro (to American Cyanamid). U. S. 2,826,559, Mar. 11. Phenol-melamine-formaldehyde resins.

Resin. C. R. Gloskey (to Metal and Thermit). U. S. 2,826,561, Mar. 11. Organotin mixed salts as stabilizers for polyvinyl chloride resins.

Resins. E. C. Shokal (to Shell). U. S. 2,826,562, Mar. 11. Hydroxy-substituted unsaturated esters prepared from polyepoxides.

Polymers. F. A. Bovey and J. F. Abere (to Minnesota Mining). U. S. 2,826,564, Mar. 11. Fluorinated acrylate polymers.

Polymers. H. A. Bruson (to Industrial Rayon). U. S. 2,826,566-7, Mar. 11. Copolymer of acrylonitrile and a 1,2-halohydrin.

Copolymers. W. S. Barnhart and R. H. Wade (to Minnesota Mining). U. S. 2,826,568, Mar. 11. Copolymers of trifluorochloroethylene with 4,6,7-trichloroperfluoroheptene-1.

Resins. R. W. Ivett (to Hercules). U. S. 2,826,570, Mar. 11. Cross-linked polyethylene.

Pipe. R. C. Pratt. U. S. 2,826,784, Mar. 18. Plastic pipe molding apparatus.

Waterproofing. J. G. Affleck (to American Cyanamid). U. S. 2,827,-396-7, Mar. 18. Acrylic polymer composition for waterproofing masonry.

Laminate. W. C. McKay (to W. R. Chance). U. S. 2,827,412, Mar. 18. Multi-ply plastic laminate.

Resin. E. J. Romatowski (to Allied Chemical). U. S. 2,827,441, Mar. 18. Catalyzed amine-modified urea resins.

Polymers. G. F. D'Alelio (to Koppers). U. S. 2,827,442, Mar. 18. Chloroalkyl allylaryl ether polymers.

Polymers. M. R. Rector and H. G. Hahn (to Dow). U. S. 2,827,443, Mar. 18. Haloethylenic polymers.

Polyethylene. M. R. Cines (to Phillips Petroleum). U. S. 2,827,444, Mar. 18. High molecular weight polyethylene.

Polymerization. D. S. Breslow (to Hercules). U. S. 2,827,446, Mar. 18. Polymerization of ethylene.

Polymers. G. Nowlin and H. D. Lyons (to Phillips Petroleum). U. S. 2,827,447, Mar. 18. Production of olefin polymers.

Laminates. R. M. Christensen and R. A. Freeman (to Pittsburgh Plate Glass). U. S. 2,827,946, Mar. 25. Laminates bonded with alkenyl substituted phenolic resins.

Leather coating. P. W. McWherter, B. B. Kine, and H. A. Alps (to Rohm & Haas). U. S. 2,828,220-1-2-3-4, Mar. 25. Coating leather with polymers containing hydroxyl groups.

Coatings. F. W. West (to Minnesota Mining). U. S. 2,828,236, Mar. 25. Coatings of perfluorochloro-olefins.

Bonding. C. M. Rosser (to American Viscose). U. S. 2,828,237, Mar. 25. Sealing polyethylene to other resins.

Tubing. H. C. Fischer (to National Fibre Glass). U. S. 2,828,239, Mar. 25. Continuously forming plastic tubing.

Ion exchange. Y. Murata (to National Aluminate). U. S. 2,828,270, Mar. 25. Resins from vinyl pyridine, polyvinyl benzene, and styrene.

Foam. A. P. Armstrong and J. B. Cameron (to Fairey Aviation). U. S. 2,828,271, Mar. 25. Foaming a phenolic resin with diazonium salts as blowing agents.

Polymer. L. E. Robb (to Minnesota Mining). U. S. 2,828,273-4, Mar. 25. Perfluorohalocarboxylic acid ester modified solid polymer of a fluoro-olefin.

Resins. M. DeGroote and K. Shen (to Petrolite). U. S. 2,828,276,-7-80-1-2-3-4-5, Mar. 25. Polyepoxide-treated phenolic resins.

Resin. M. Kosmin (to Monsanto). U. S. 2,828,278, Mar. 25. Resin from polyesters and aromatic vinyl compounds.

Resins. D. W. Lewis (to Westinghouse). U. S. 2,828,279, Mar. 25. Thermosetting organosilicon resins.

Polymers. R. N. MacDonald (to Du Pont). U. S. 2,828,286, Mar. 25. Polymers of formaldehyde.

Polymers. T. L. Cairns, E. T. Cline, and P. J. Graham (to Du Pont). U. S. 2,828,287, Mar. 25. Fluoraldehyde-modified polyoxymethylene.

Resins. K. Taube, W. Benade and O. Weber (to Bayer). U. S. 2,828,288,

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Mar. 25. Dicyandiamide-formaldehyde condensates.

Resins. J. W. Mench (to Eastman Kodak). U. S. 2,828,289, Mar. 25. Polyvinyl acetal acid dicarboxylates.

Resins. J. R. Caldwell (to Eastman Kodak). U. S. 2,828,290, Mar. 25. Copolyesters of a glycol, an aromatic dibasic acid, and a short chain hydroxy acid.

Resins. J. H. Saunders (to Monsanto). U. S. 2,828,291, Mar. 25. Resin condensates of a glycol, a diamine, and a urea.

Polymers. H. W. Coover, Jr. (to Eastman Kodak). U. S. 2,828,292, Mar. 25. Polymers of 3-alkylidene phthalimidines.

Resins. A. Ullrich. U. S. 2,828,294, Mar. 25. Mineral oil resins.

Copolymer. J. M. Butler (to Monsanto). U. S. 2,828,295, Mar. 25. Cyano ether ester copolymer.

Mold. W. Strauss (to F. J. Stokes). U. S. 2,828,507, Apr. 1. Injection molding press.

Molding. M. Labarre (to Specialties Alimentaires). U. S. 2,828,508, Apr. 1. Injection molding.

Molding. R. E. Smucker and J. M. Harrison (to Crown Machine). U. S. 2,828,509, Apr. 1. Plastic molding machine.

Copolymer. S. A. Murdock, T. G. Taylor and T. B. Lefferdink (to Dow). U. S. 2,829,066, Apr. 1. Antistatic copolymer of sulfonated styrene and vinyl pyridine.

Coating. P. L. Williams (to Adhesive Tapes). U. S. 2,829,073, Apr. 1. Anti-stick polyvinyl coating.

Cellular bodies. H. Lindemann (to Lonza Electric). U. S. 2,829,117, Apr. 1. Cellular plastics.

Polyethylene. W. Wehr (to Deutsche Gold-und Silber). U. S. 2,829,118, Apr. 1. Shaped bodies.

Copolymers. J. R. Dudley and P. Adams (to American Cyanamid). U. S. 2,829,119, Apr. 1. Melamine-acrylic copolymers.

Resin. A. Napravnik and D. J. Lieb (to Borden). U. S. 2,829,124, Apr. 1. Epoxide resin.

Resin. R. J. Slocombe and G. L. Wesp (to Monsanto). U. S. 2,829,-125-8, Apr. 1. Clear terpolymers of acrylic acid, vinyl methyl ketone, and styrene.

Resins. T. J. Suen and Y. Jen (to American Cyanamid). U. S. 2,829,126, Apr. 1. Urea resins.

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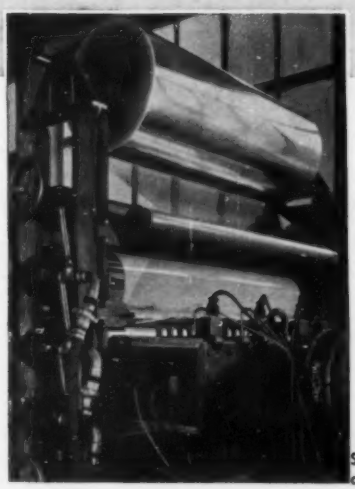

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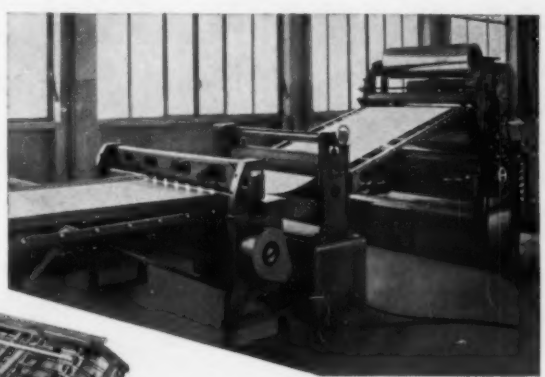

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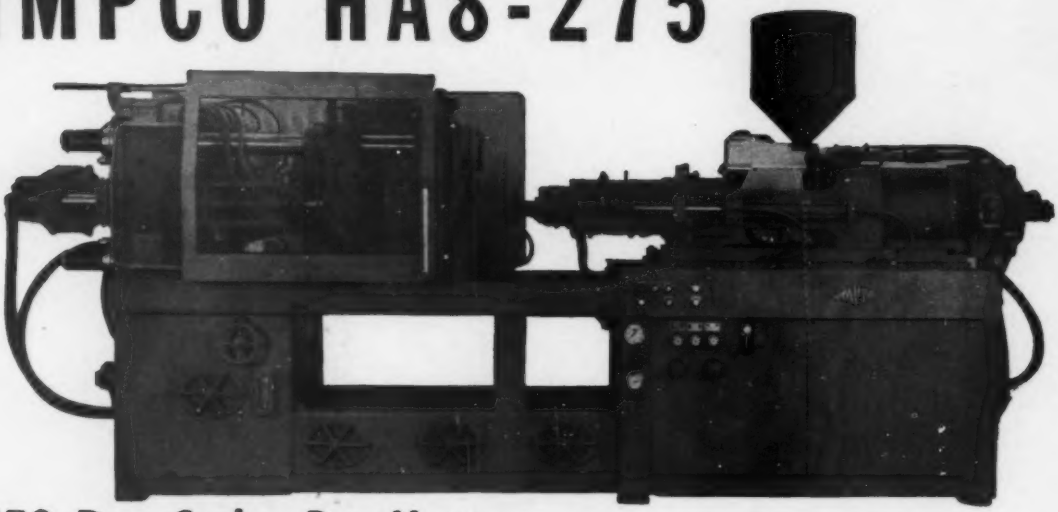

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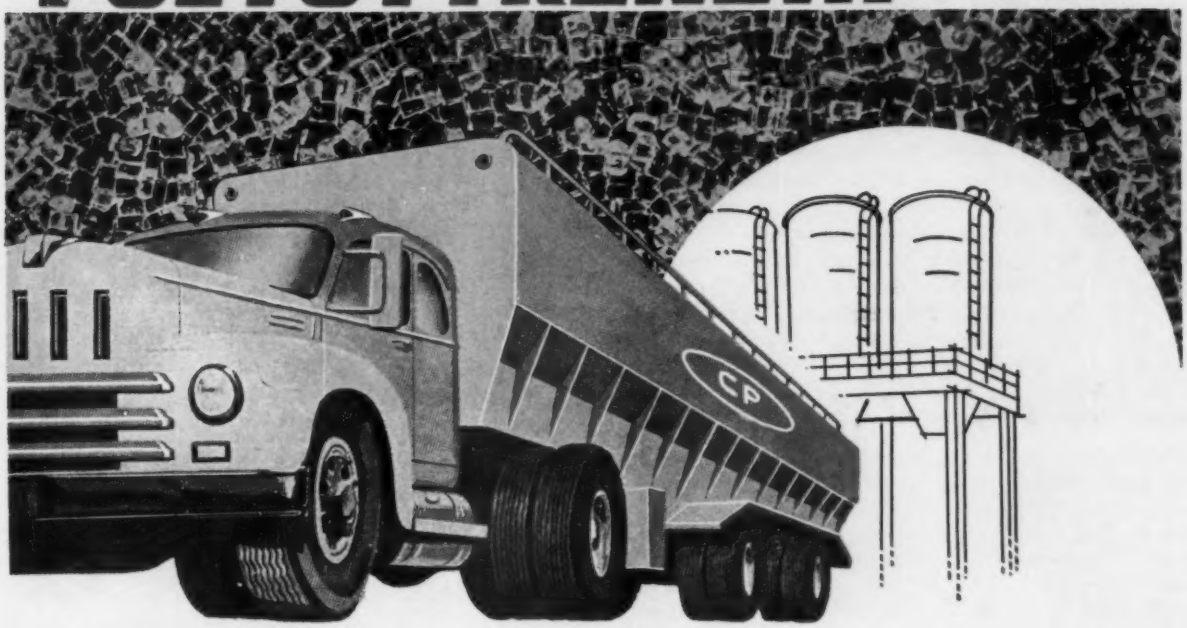

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Double-drum tumbler

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Medium injection machines

These fully automatic molding machines are available in short- and long-stroke models in both 12- and 16-oz. sizes. The table below gives the major specifications on both sizes. The 3214 (short stroke) models differ from the 3220 models listed only in that the clamping stroke and maximum daylight are 6 in. less. Pumps are Vickers-made, control valves are manifold-mounted, and compensating weigh feeder is standard, though not mandatory. Optional features include a smaller injection ram for pressures up to 30,000 p.s.i., low-pressure mold closing, core-pulling attachment, mold stop control, nylon molding kit, and several adaptations for special jobs. *Lombard Governor Corp., Ashland, Mass.*

Sheet squarer

A squaring device takes pressed laminates and, in two passes at right angles to each other, saws all the edges square. Even warped sheets are cut accurately square; maker claims that edge is cleaner than sheared edge. The basic model will handle sheets from 2 by 5 ft. to 4 by 10 ft. at from 4 to 12 sheets per minute. Optional: splitting on one or both passes. *Mereen-Johnson Machine Co., 4401 Lyndale Ave. North, Minneapolis 12, Minn.*

Lombard injection machine specifications

Machine	*3220-12*	*3220-16*
Single shot (styrene), oz.	12	16
Plasticating capacity, lb./hr.	125	150
Pressure on material (adjustable up to) p.s.i.	20,000	20,000
Injection plunger stroke, in.	12	12
Plunger speed (adjustable up to), in./min.	288	215
Rated casting area, sq. in.	310	310
Closing pressure, tons	325	325
Mold clamping stroke (adjustable), in.	8½ to 20	8½ to 20
Maximum mold size, in.	20¼ by 36	20¼ by 36
Minimum mold thickness, in.	8	8
Maximum mold thickness, in.	22	22
Maximum daylight opening, in.	42	42
KW on heater	24.4	24.4
Capacity of pumps, gal./min.	48.3	48.3
Dry cycle/hr. (with full 12-in. injection stroke)	420	350

Small automatic sheet former

The Lab-Vac forming machine series comes in three models of increasing versatility. All have a maximum forming area of 14 by 20 in., with adjustable clamping frames. The two more elaborate models have automatic cycling, air eject, pressure forming and air-cushion forming facilities, and a maximum depth of vacuum draw of 10 inches. They differ in that one has two platens, the other has one. The two-platen machine has a 9-cu. ft./min. vacuum pump, requires 30 amp. at 220 v.; corresponding values for the one-platen automatic are 5.3 cu. ft./min. and 23 amperes. These machines are especially designed for laboratory and development work. Prices: $889, $1490, and $3500. *Comet Industries, Franklin Park, Ill.*

Roll leaf stamper

The Kensol 15 is a hand-operated roll leaf production stamping press weighing 106 pounds. Maximum impression area is 2 by 4 in.; daylight is 6 inches. Action is of rack-and-pinion type that is easily converted to pneumatic operation. Heating head is thermostatically controlled. Throat depth is 6 in.; stroke is 1.75 in.; heater power is 200 w. A 2- by 4-in. hot-plate chase is included. Other chases and pallets are available. Price: $395. *Olsenmark Corp., 124 White St., New York 13, N. Y.*

Portable marker

The No. 230 portable printer, weighing only 6.5 lb., is suitable for identification marking of round, polygonal, or flat extrudates. It can be adapted for in-

* Specifications and claims made and appearing in these pages are those of the manufacturers of the machinery and equipment described and are not guaranteed by MODERN PLASTICS.

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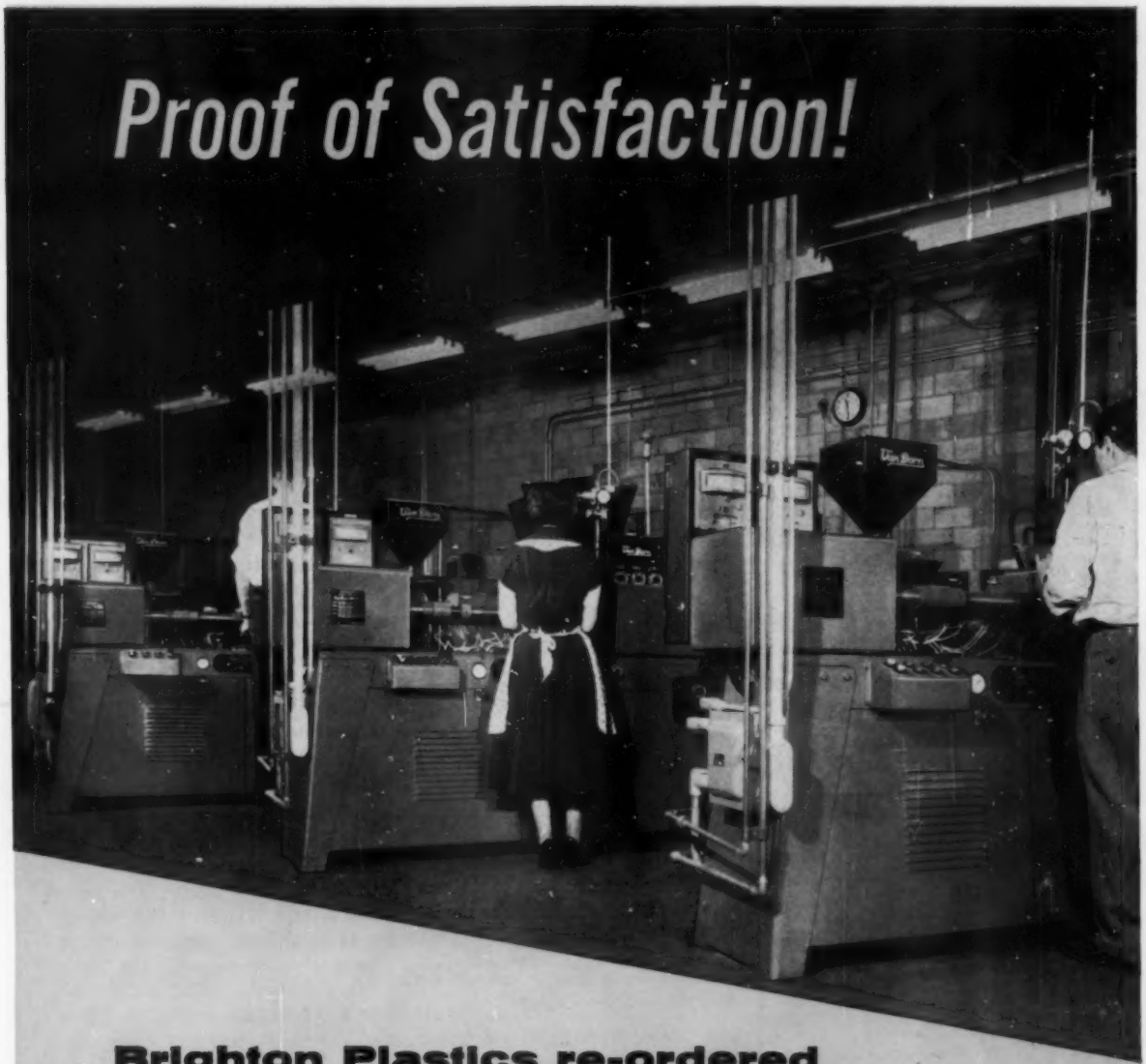

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VAN DORN presses again and again

Several years ago Brighton Plastics of Rochester installed a Van Dorn H-250 to produce nylon gears for electric clocks. They inject gears in a multiple cavity mold at a production rate of 5 shots per minute. The Van Dorn press performed so well that Brighton ordered another, and later still, a third.

Van Dorn presses mold nylon better because they insure:

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2. Easier maintenance of close tolerances
3. Lower mold investment
4. Less waste in purging
5. Automatic cycling

The outstanding features of Van Dorn presses for molding all thermoplastics are fully described in literature available upon request.

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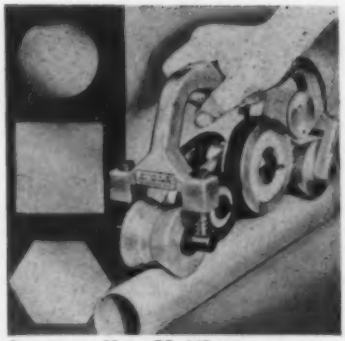


James H. Matthews
portable marker for round, flat, and polygonal shapes

production-line marking. Changes in inscription are made with quick-change, rubber type; logotypes are available in a choice of styles. *Jas. H. Matthews & Co., 3942 Forbes Ave., Pittsburgh 13, Pa.*

Punch press

The BT-12 is a 12-ton press having a 160-lb. flywheel. Bearings are bronze; clutch is of single-pin, knife design. Critical dimensions are: ram stroke, up to 1.75 in.; throat clearance, 5 in.; maximum daylight with ram down, 7 inches. The 1.75-in. crankshaft has an adjustable-tension brake. Press tilts up to 30°. Prices: floor model $437.50; bench model $410. *Alva Allen Industries, Clinton, Mo.*

Double-header sealer

The Model 6000-SB60 electronic heat sealer has a single generator serving two back-to-back presses. Designed to meet the requirements of plants with fluctuating production demands, the machine can be operated as two units, sealing alternately, during times of high production. Generators are available in capacities from 6 to 10 kilowatts. *Sealomatic Electronics Corp., 429 Kent Ave., Brooklyn, N. Y.*

High-vacuum cold traps

Humidity in the air has long been a real bugaboo in vacuum metallizing (see p. 109 of this issue). Refrigerated traps now available get cold enough (—115° F. or lower) to condense moisture out of air even at the low pressures (0.5 micron Hg) used in metallizing. The trap consists of a cooling coil inserted between the diffusion pump and the high-vacuum valve. Ice can be removed in minutes by recycling hot gas from the compressor through the coil. Cost of installed unit is about same as a year's supply of liquid nitrogen for old-style trap. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.*

Scrap granulators

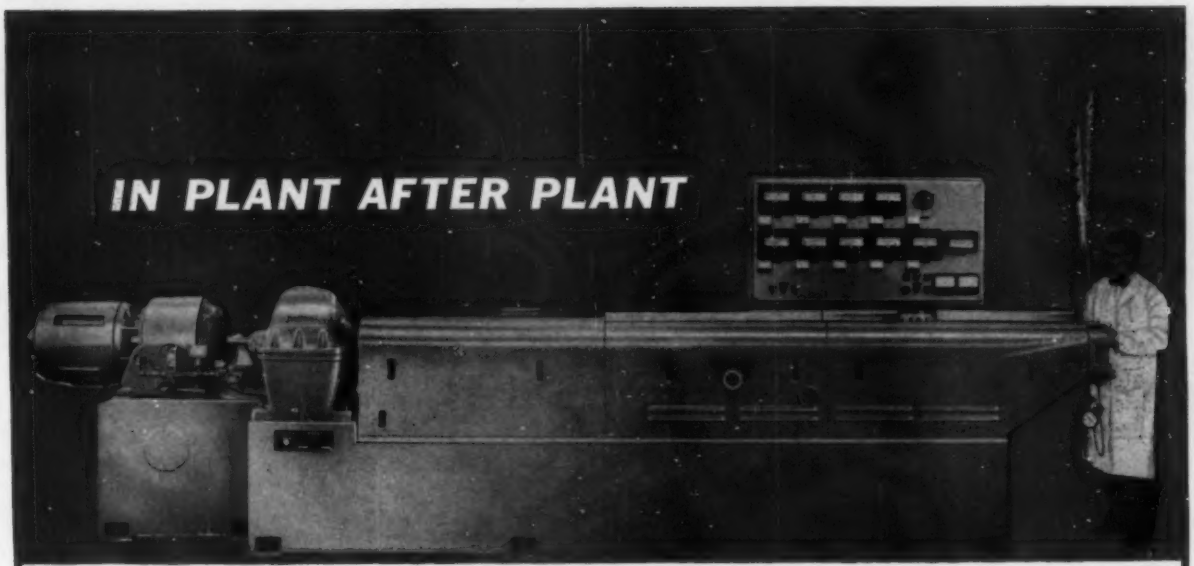
Two scrap granulators, the KC-12 and KC-9, have three rotating and four fixed blades, and a large-area, semi-circular screen with opening from ⅛ in. up. Respective specifications on the KC-12 and KC-9 are: Capacity: 200 to 400, and 100 to 200 lb./hr.; feed opening: 12.2 by 8 in., and 10 by 6.2 in.; power: 7.5 to 15, and 5 to 7.5 hp.; speed: 1000 to 1400, and 1200 to 1500 r.p.m.; floor space: 36 by 72, and 23.5 by 52 inches. *American Pulverizer Co., 1249 Macklind Ave., St. Louis 10, Mo.*

Small preplasticating injection machine

The PE-15 is a high-speed injection machine with an auxiliary preplasticating cylinder that is rated at 15 oz. of polystyrene per shot. Plasticating capacity is 80 lb./hr. of that plastic. The main and holding pumps are driven by a 40-hp. motor, attain a clamping force of 215 tons, and a top injection pressure of 20,000 p.s.i. Injection stroke is 9 in., clamping stroke is 12 in., and maximum daylight (without stripper box) is 30 inches. Molds up to 16 by 25.5 by 12 in. thick may be accommodated. Can be run manually or automatically. *Watson-Stillman Press Div., Farrel Birmingham Co., Inc., 565 Blossom Rd., Rochester 10, N. Y.*

Calender versatilizer

A Crown Compensator can now be obtained as an attachment to existing calenders that are not equipped with roll crossing, but that have connecting gears mounted on the rolls. The device consists of complete new bearings for the roll to be crossed, a new swivel-connecting gear for this roll, and a small gearmotor for varying the amount of crossing. The main outer bearing fits into the frame in the customary man-



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50 PAGE ILLUSTRATED BULLETIN E-3 GIVES COMPLETE DETAILS ABOUT PRODEX EXTRUDERS

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ner with the usual side clearance. The existing screw mechanism is used for roll adjustment.

This mechanism can be built into almost any three- or four-roll calender in which the rolls can be removed through the frame openings, at a fraction of the cost of a new machine. *Farrel Birmingham Co., Ansonia, Conn.*

2.5-ounce injection machine

The Model H-260 horizontal injection molding machine is rated at 2.5 oz. of acetate per shot, with a plasticating capacity of 30+ lb./hr. of that plastic. It dry cycles in 5 sec. and accepts molds up to 8 by 10 in., with thicknesses ranging from 3 to 8.5 inches. Clamping force is 30 tons, top injection pressure is 12,000 p.s.i., and maximum injection rate is about 4.5 cu.in./sec. Heaters are rated at 3.1 kw. on cylinder, 160 w. on nozzle. Several variations on the basic model are offered. The H-260 automatic machine with a high-capacity heater sells for $6600. Optional extras include special equipment for molding nylon, chrome plating on cylinder and nozzle, etc. An important option, priced at $130, is an automatic lubrication system. *Van Dorn Iron Works Co., 2685 E. 79th St., Cleveland 4, Ohio.*

Cartridge heaters

To the Firerod line of cartridge heaters has been added a ⅝-in. diameter unit, available in standard lengths from 1 to 12 in., and special lengths up to 30 inches. Amperage ratings run to 20.6 amps., depending on heater size and voltage. *Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.*

High-speed extruders

The D-S Thermatic series of plastics extruders is available in 2.5-, 3.5-, 4.5-, 6-, and 8-in. screw diameter models. Helical or herringbone gears, bigger thrust bearings, and quadruple keying of screws, permits the new line to deliver more power to screws at higher speeds (up to 160 r.p.m. so far, and expected to reach 200 r.p.m.). Bearing at feed section can be removed for inspection without removing screw or other parts. Labyrinth-type oil seals reduce maintenance. Temperature control is improved version of Therma-Fin design. Cylinders are Xaloy lined. Hinged head clamp opens by loosening one bolt, swings clear of head flange. *Davis-Standard, Div. of Franklin Research Corp., Mystic, Conn.*

Wire and tube marker

An electric marking machine, with a keyboard like that of a typewriter, uses foil to heat-mark wire and tube stock from 1/16 to ½ in. in outside diameter. Type sizes are easily interchanged. Temperature of making head may be set to any temperature up to 800° ± 20° F. Characters can be marked at rates over 100 per minute. Variable pressure setting gives right pressure for each material being marked, whether soft or hard. *Defiance Machine & Tool Co., 1920 S. Vandeventer Ave., St. Louis 10, Mo.*

Welding equipment

Kamlar welding equipment includes two hand guns for welding thermoplastics. The Model HT is fitted with a standard welding (hot-air) tip or with a high-speed tacking tip that permits rodless tacking. This tip fuses edges of sheets strongly enough so that they can be moved around without coming apart. Accessories adapt this model to the heat sealing of vinyl strip on vinyl tank linings, etc.

The Model HS is fitted with high-speed tips that hold, feed, and guide rod automatically, permitting one-hand operation at speeds up to 50 in./minute. The tip cuts rod cleanly at end of each weld, and tests have shown welds to be exceptionally strong. Both models use Calrod heating elements, have stainless steel tips and air-cooled handles. Temperature is adjusted by regulating air flow. *Laramy Products Co., 90 South St., Hingham, Mass.*

Tray driers

Circulating air ovens designed for use with dehumidifying equipment (not included) are divided into two independent sections, each with its own door. The two models differ in size, the smaller having a capacity of 360 lb. of acetate or 172 lb. of nylon, the

larger having capacity of 600 lb. of acetate or 400 lb. of nylon. Dried, heated air passes at high velocity above and below each tray, minimizing dead spots. Trays are aluminized steel with wire edging. Standard construction is one-piece, but knocked down construction can be had at extra cost where required. The heater and blower ratings are 6 kw. and ⅓ hp. for the smaller unit, 9 kw. and ½ hp. for the larger. *Lydon Brothers, Inc., 85 Zabriskie St., Hackensack, N. J.*

Tube marker

A tube imprinting machine will code, date, etc., rubber and plastic tubing, round rod stock, or coated wire, at speeds up to 30 marks per minute. The unit uses a heated dye-transfer process, with a variety of colors available, the imprint being made by brass dies. *Industrial Marking Equipment Co., 454 Baltic, Brooklyn, N. Y.*

Painting equipment

The Model 4800 painting machine, with several downward-spraying guns mounted on a carriage with a maximum traverse of about 3.5 ft., is particularly suited to painting large parts. Parts are held firmly in mask by pressure pad. Traverse of carriage is by hydraulically powered chain drive that does not stop in mid-stroke. Timing is adjustable. *Finish Engineering Co., Inc., 1115 Cherry St., Erie, Pa.*

An automatic mask washer operates while operator paints, swishing masks in solvent bath that occupies 2.2 sq. ft. of the floor next to the spray booth. Spent solvent drains to an auxiliary tank below (6-gal. capacity). Agitator shaft is driven by air motor, and a fusible link automatically drops cover of washing tank, smothering any fire that might start in the solvent. *The Protectoseal Co., 1920 So. Western Ave., Chicago 8, Ill.*

Single drum tumbler

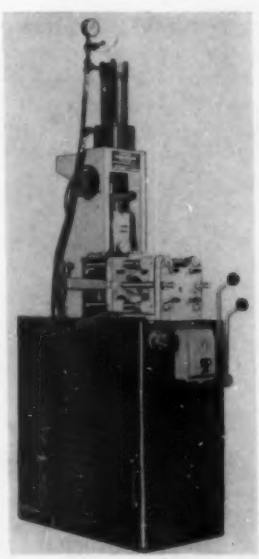
The Canuck Mk. I tumbler is a heavy duty machine that tumbles a single drum end over end 30 times a minute. Drum may be any size up to 55 gallons. The Canuck is driven by a ½-hp., single-phase motor, weighs 400 lb., has over-all dimensions 4 by 3 by 3.5 feet. It need not be anchored. *Barnett J. Danson & Assoc., Ltd., 1912 Avenue Rd., Toronto 12, Ont., Canada.*

Roll temperature thermocouples

These couples are designed for attachment to mill frames, etc., so that tip is in contact with roll surface. Features claimed are: fast response, wear resistance, compactness, and no heat loss due to air currents. Temperature reading is unaffected by roll speed. The sensing element is a brass plug flush-mounted in a spring-loaded TFE-fluorocarbon-resin plunger. The TFE shell bears against the roll surface, providing insulation for the element. Junction may be iron or copper with constantan, or Chromel-Alumel. *Conax Corp., 2300 Walden Ave., Buffalo 25, N. Y.*

1/3- to 1-oz. injection machine

The Universal model Mini-jector will accept two types of molds—parting-line-sprued molds, and larger straight-block molds. V-block type is used for insert molding of wires, cores, etc., while straight-block molds are used for production runs of larger-area molded items. Interchangeable cylinders offer ⅛ to 1-oz. capacity selectivity. *Newbury Industries, Newbury, Ohio.*



Newbury Industries ⅛ to 1 oz. Mini-jector accepts two types of molds

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"Resins-Rubbers-Plastics Yearbook 1957"

Edited by H. Mark, E. S. Proskauer, V. J. Frilette

Published in 1958 by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. 1144 pages. Price: $35.00.

The abstracts presented in this volume (in English) of papers originally published during 1957 in outstanding domestic and foreign journals, are far more complete than those conventionally used. In many cases they contain original data, graphs, charts, photographs, etc., so that readers will not always find it necessary to go to the original work.

Many of the abstracts are from sources which are not always readily accessible, such as Soviet publications.

Excellent indexes and complete references are provided.

Fire protection. "Fire Hazards of Welding and Cutting in the Plastics Industry." Designed to prevent fires in welding and cutting operations. 4 pages. *The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.*

Pyrometers. Accuracy, automatic compensation, ruggedness, simplicity of operation, durability, interchangeability, etc., of the Pyro surface pyrometer. Catalog 168. 6 pages. Special features, principles of operation, etc. for radiation, immersion, surface, optical, micro-optical, and indicating pyrometers. Catalog 175. 8 pages. *The Pyrometer Instrument Co., Inc., Bergenfield, N. J.*

Research chemicals. "Research Chemicals from Dow" describes 160 chemicals—inorganics, saturated and unsaturated aliphatics, aromatics, and heterocyclics—available in sample quantities. 40 pages. "Styrene Oxide" describes 14 different types of reactions involving styrene oxide; includes uses, health hazards, 44-item bibliography. 18 pages. *Technical Service & Development, The Dow Chemical Co., Midland, Mich.*

PVC resin. Specifications, advantages, heat stability, etc. for Escambia PVC Pearls, a new type polyvinyl chloride resin. 4 pages. *Escambia Chemical Corp., 261 Madison Ave., New York 16, N. Y.*

Daylighting products. Specifications, architectural and engineering details, suggested applications, etc. for fibrous glass reinforced plastics products in skylights, sash and sliding, walls, and ventilating units. Bulletin 572. 22 pages. *Resolite Corp., Zelienople, Pa.*

Reinforced plastics. Information on fabricating techniques, including matched die molding, vacuum bag molding, contact molding, and tube wrapping of fibrous glass reinforced parts. 4 pages. *Atlas Plastics, Inc., 683 Seneca St., Buffalo 10, N. Y.*

Plastics research. Facilities, accomplishments, etc. of this independent laboratory doing research in plastics. 8 pages. *Cincinnati Testing & Research Laboratories, 1240 Glendale-Milford Rd., Cincinnati 15, Ohio.*

Monomers and polymers. Prices for over 500 monomers and polymers for research, including new cross-linking agents, monomers for poly-electrolytes, and substituted ethylenimines. Catalog A-7. 18 pages. *Monomer-Polymer Laboratories, The Borden Chemical Co., 5000 Langdon St., Philadelphia 24, Pa.*

Plastic pipe. Uses, advantages, etc. of Kralastic, PVC, and butyrate pipe for transmission of oil, gas, water, industrial chemicals, etc. 4 pages. *Southwestern Plastic Pipe Co., Box 117, Mineral Wells, Tex.*

Vinyl and rubber moldings. Laboratory facilities, molding operations, and services available. Bulletin 715. 6 pages. *The Ohio Rubber Co., a Div. of the Eagle-Picher Co., Willoughby 1, Ohio.*

Vinyl coatings. "Quelcor Systems for Corrosion Prevention" deals with curtailing corrosion in plants. Bulletin 83. 4 pages. "Quelspray, PVC Plastisol for Spray Application" concerns PVC plastisols as chemically resistant coatings for metal equipment. Data Sheet 86. 2 pages. "Quelcor 415 and 417." Physical properties, industrial uses, application, and precautions. 2 pages. "Quelcor PVC Coatings for Metal Floor Grating." PVC plastisols as chemically resistant coatings for metal equipment and structures. Data Sheet 84. 2 pages. "Quelcor Plastisol Coatings." Physical properties and efficiency in dealing with chemical corrosion. Data Sheet 75. 2 pages. *Quelcor, Inc., Front & Broomall Sts., Chester, Pa.*

Nylon. Physical properties chart, design and fabricating data for Polypenco nylon. 28 pages. Performance characteristics, installation, available sizes, etc. of Nylaflow pressure tubing. Bulletin BR-3. 4 pages. Uses, properties, characteristics, stock sizes, properties data, etc. for Nylon 101. Bulletin BR-1. 8 pages. *The Polymer Corp. of Penna., 2140 Fairmont Ave., Reading, Pa.*

Polyethylene. "Catalog of Technical Reports" lists a number of reports evolved from research by Army, Navy, Air Force, and other agencies, as well as documents captured from the Germans during World War II. Lists titles, source, language, price, and report number. Catalog price: 10 cents. CTR-332. 4 pages. *OTS,*

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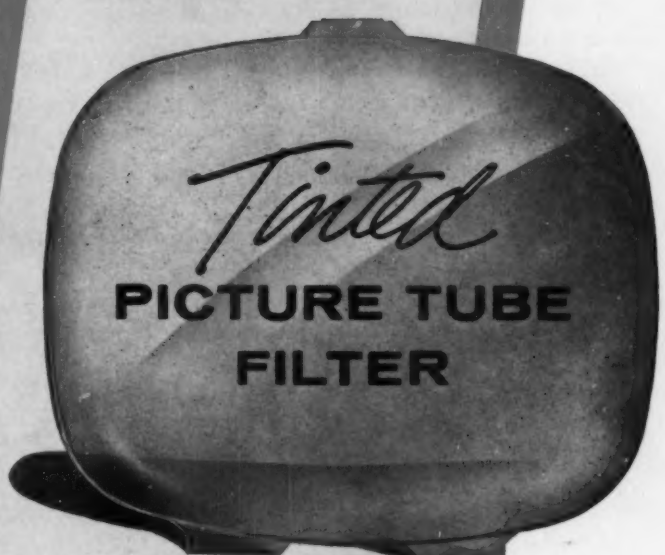

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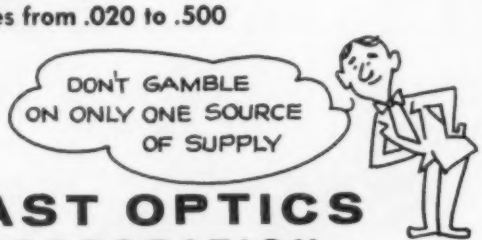

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Sheets, rods, and tubes. Catalog gives table of properties, price list, etc. for acrylics, fluorocarbons, vinyl, acetate, phenolics, polyethylene, polystyrene, and nylon sheets, rods, and tubes. 48 pages. *Almac Plastics, Inc., 600 Broadway, New York 12, N. Y.*

Precision castings. "New-Cast Process for Making Precision Castings"—die-casting dies, forging dies, and molds for plastics, glass, and rubber. 8 pages. *Newark Die Hobbing & Casting Co., 20 Scott St., Newark 2, N. J.*

PVC sheet linings. Covers three types of polyvinyl chloride linings for corrosion protection, including a comparison of conventional and unplasticized linings in terms of their resistance to acids, alkalies, salts, plating solutions, organic compounds, etc. Catalog LC-58. 12 pages. *Kaykor Industries, Inc., Div. of Kaye-Tex Mfg. Corp., Yardville, N. J.*

Pyrometer. Advantages, specifications, and ranges of the Alnor Pyrotroller, an indicating-controlling pyrometer. Bulletin 3885. 6 pages. *Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill.*

Fibrous glass panels. Uses for fibrous glass reinforced plastics paneling in industrial and commercial construction. 4 pages. *Filon Plastics Corp., 2051 E. Maple St., El Segundo, Calif.*

Fibrous glass materials. "Fiberglas Materials for Heat and Noise Control, Air Filtration and Reinforcements" describes the use of fibrous glass materials in appliance and equipment manufacture, automotive and transportation field, etc., as reinforcement for plastics and for coated and laminated products. 31 pages. *Owens-Corning Fiberglas Corp., Owens-Illinois Bldg., Toledo 1, Ohio.*

Plastics tooling. "Plastics Tooling with Epocast" describes the use of epoxy resins in industry—aircraft, automotive, machine

shop, metal trades, ceramics, marine, etc. 4 pages. *Furane Plastics, Inc., 4516 Brazil St., Los Angeles 39, Calif.*

Thermoset knobs. Data on line of standard plastic knobs, available in phenolic or urea in any color. 8 pages. *Waterbury Companies, Inc., P. O. Box 1032, Waterbury 20, Conn.*

Production facilities. "Products of Atlas" describes the chemical products and services offered by the company. 16 pages. *Atlas Powder Co., Wilmington 99, Del.*

Plastics for building. Proceedings of the fourth meeting of the Plastics Study Group of the Building Research Institute, covering "Plastics for Roof Construction" and "A Case Study—Plastics in a New Building." Includes 12 technical papers. 128 pages. Price: $3.00. *Building Research Institute, 2101 Constitution Ave., Washington 25, D. C.*

Epoxy casting resin. Mixing, mold preparation, casting, curing, detailed physical properties, etc. for Epolite epoxy casting resin. 4 pages. *Rezolin, Inc., 1651 18th St., Santa Monica, Calif.*

Slush-cast molds. "How to Slush-cast Molds for Epoxy Encapsulation" describes use of Cerrotru, a low-temperature melting bismuth-tin alloy. Bulletin G6. 4 pages. *Cerro de Pasco Sales Corp., 300 Park Ave., New York 22, N. Y.*

Polyethylene resins. Versatility of Tenite polyethylene resins and range of applications—housewares, toys, appliances, packaging, paper coating, insulation, and pipe. 36 pages. *Eastman Chemical Products, Inc., Kingsport, Tenn.*

Polyethylene ducting systems. Technical data on corrosion-proof ventilating and exhaust systems. 12 pages. "Welded Polyethylene Duct Systems Resist Corrosion, Cut Costs for Exhausting Alkali and Acid Fumes." 4 pages. *American Agile Corp., P. O. Box 168, Bedford, Ohio.*

Parting films. "Ferro Liquid Parting Films for Polyester and

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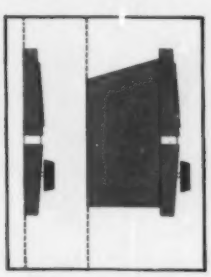

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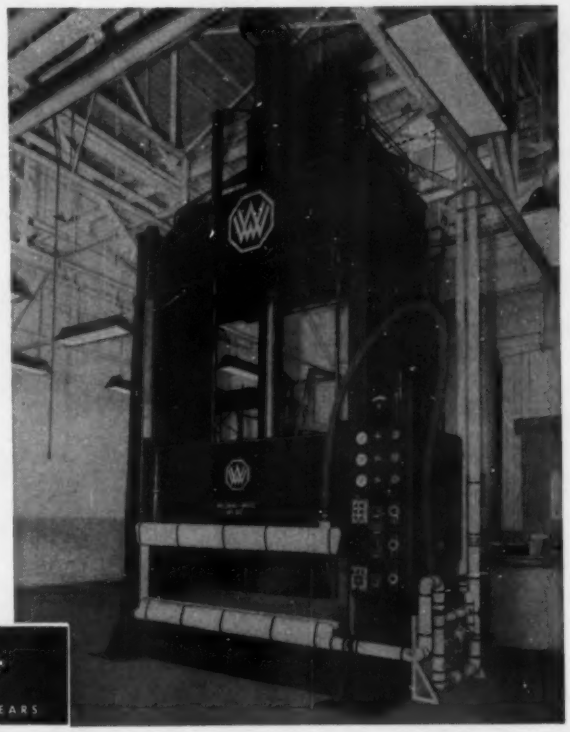

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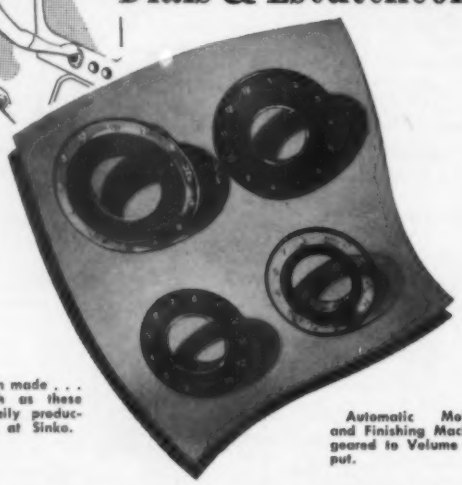

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LIQUID POLYMER. 18-page booklet discusses "LP-3", a liquid polysulfide polymer that can be converted in place to a rubber. For potting and casting compounds, in adhesives and coatings, and for epoxy and phenolic resin modification. Properties, specifications, formulae, tables and graphs included. Thiokol Chemical Corp. **(G-802)**

PLASTICS DEFLASHING. 8-page illustrated booklet describes advantages of the Wheelabrator Deflasher for high-speed, automatic mechanical deflashing of molded plastic parts, as compared to manual deflashing. Wheelabrator Corp. **(G-817)**

PARTICLE ACCELERATORS. Illustrated 12-page bulletin describes design and performance features of Van de Graaf and linear accelerators for radiographic inspection, graft polymerization and crosslinking. High Voltage Engineering Corp. **(G-824)**

Any of the booklets described here, plus many others—forty-four in all—are available for the asking, without charge or obligation.

Just turn to the Manufacturers' Literature Section in this issue (pages 177, 178), circle the numbers corresponding to the booklets you want, fill in the reply postcard, and mail. No postage needed.

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Epoxy Molding." 5 pages. *Ferro Corp., Color Div., 4150 E. 56th St., Cleveland 5, Ohio.*

Molding machinery. Descriptive data, specifications, etc., for plastics injection molding machines, extruders, molds, dies, and auxiliary equipment. 48 pages. *R. H. Windsor, Ltd., Leatherhead Rd., S. Chessington, Surrey, England.*

Polyethylene-corrugated board shipper. Technical report on shipment of liquids in seamless polyethylene bottles—available in sizes up to 15 gal.—and corrugated shipper, including advantages, suggested uses, etc. 2 pages. *Hinde & Dauch, Sandusky, Ohio.*

Epoxy Molding Compound. Advantages, physical and electrical properties, chemical resistance range, etc. of Tybon epoxy molding compound. 6 pages. *Booty Resineers Div., American Marietta Co., 42 S. 3rd St., Newark, Ohio.*

Technical Plastics. Full line of sheets, rods, tubes, and fabricated parts available from this manufacturer and fabricator of industrial thermosetting laminated plastics. 28 pages. Form S-358-75. *Synthane Corp., Oaks, Pa.*

Viscosity of plastisols. "Effects of Shear Rates, Temperature, and Time on the Viscosity of Plastisols" provides data on the viscosity-temperature characteristics of many plasticizer systems; the viscosity of these systems at low, medium, and high shear rates; and the viscosity stability of these systems after one week aging at room temperature. Plasticizers reported include phthalates, phosphates, adipates, epoxies, polymerics, and secondary and special primary plasticizers. 34 pages. *Firestone Plastics Co., Div. of the Firestone Tire & Rubber Co., Pottstown, Pa.*

Injection molding. "The Story of Pre-Compressed Molding" describes operating technique, case histories, and advantages of a new technique for thermoplastic materials. 20 pages. *W. R. Grace & Co., Polymer Chemicals Div., 225 Allwood Rd., Clifton, N. J.*

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Plastics

Production and sales figures in 1000 lb.* for February and March 1958

Materials	*Total p'd'n first 3 mos. of 1958‡*	*Total sales first 3 mos. of 1958‡*
Cellulose plastics:[a]		
Cellulose acetate and mixed ester:		
Sheet, under 0.003 gage	4,199	4,127
Sheet, 0.003 gage and over	4,460	3,905
All other sheets, rods, tubes	2,012	1,953
Molding, extrusion materials	20,468	20,353
Nitrocellulose sheets, rods, tubes	916	969
Other cellulose plastics	2,281	1,697
Phenolic and other tar-acid resins:		
Molding materials[a]	42,718	37,557
Bonding and adhesive resins for:		
Laminating (except plywood)	15,184	9,796
Coated and bonded abrasives	3,485	2,506
Friction materials (brake linings, clutch facings, etc.)	3,096	2,607
Thermal insulation	10,740	9,935
Plywood	11,490	9,398
All other bonding uses	9,807	9,634
Protective-coating resins	7,116	5,468
Resins for all other uses	7,593	5,324
Urea and melamine resins:		
Textile-treating resins	8,821	8,401
Paper-treating resins	6,636	5,297
Bonding and adhesive resins for:		
Plywood	21,274	21,366
All other bonding and adhesive uses, including laminating	9,723	9,197
Protective-coating resins	7,000	5,256
Resins for all other uses, including molding	24,949	23,645
Styrene resins:		
Molding materials[a]	90,575	100,337
Protective-coating resins	22,645	21,134
Resins for all other uses	38,570	30,879
Vinyl resins, total[b]	189,630	168,644
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		17,360
Sheeting (resin content)		12,581
Molding and extrusion (resin content)		44,554
Textile and paper treating and coating (resin content)		12,070
Flooring (resin content)		24,049
Protective coatings (resin content)		7,403
All other uses (resin content)		11,031
All other vinyl resins for:		
Adhesives (resin content)		10,630
All other uses (resin content)		28,965
Coumarone-indene and petroleum polymer resins:	55,159	55,027
Polyester resins:		
For reinforced plastics	21,594	19,439
For all other uses	2,485	2,178
Polyethylene resins, total:	196,898	174,891
For film		64,255
For all other uses		110,636
Miscellaneous:		
Molding materials[a, d]	9,261	9,509
Protective-coating resins[e]	2,953	1,715
Resins for all other uses[f]	33,709	28,330

*Dry basis designated unless otherwise specified. †Revised.
‡Partially estimated.
[a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by the U. S. Tariff Commission

February†		March‡	
Production	*Sales*	*Production*	*Sales*
1,230	1,225	1,680	1,688
1,471	1,282	1,490	1,424
582	662	653	734
6,677	6,427	7,653	7,493
290	291	278	302
671	432	736	572
13,213	11,799	13,782	12,671
4,946	3,198	5,249	3,401
973	889	1,152	701
1,016	1,006	774	632
3,276	3,037	3,118	3,212
3,581	2,628	3,840	3,223
3,060	3,099	2,718	2,908
2,369	1,708	2,455	1,668
2,434	1,666	2,168	1,543
†2,827	†2,803	2,817	2,566
†2,270	†1,768	1,953	1,729
6,247	6,611	7,363	7,767
2,853	3,348	3,445	3,129
2,091	1,696	2,293	1,634
7,674	7,100	8,324	7,630
29,656	33,428	32,369	33,861
7,497	6,773	7,458	7,128
12,560	9,969	12,859	10,225
58,327	54,949	62,326	54,798
	5,902		5,588
	4,412		4,050
	13,907		14,286
	4,468		3,567
	7,964		8,523
	2,250		2,268
	3,369		3,591
	3,484		3,933
	9,193		8,992
18,350	18,180	18,290	18,341
7,198	6,537	7,658	6,654
712	684	978	779
†61,801	54,380	†64,575	57,880
	18,448		17,631
	35,932		40,249
2,922	3,076	2,817	2,781
861	538	1,046	536
10,016	9,059	11,538	9,812

are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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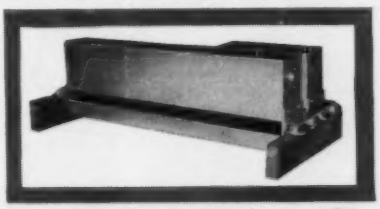

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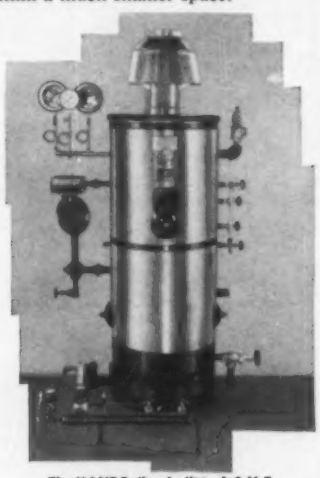

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The Platform

Where readers may voice their opinions on any phase of or problem in the plastics industries, controversial or otherwise. The editors of MODERN PLASTICS take no responsibility for opinions expressed in letters herein.

Polymer processing—new engineering specialty

The Editor, MODERN PLASTICS:

Within the past two decades the synthesis of polymers has grown into a multi-billion-dollar business, the fastest growing segment of the chemical industry. During this period the consumption of natural polymers (such as rubber and cellulose) was relatively constant; there was a phenomenal increase in the consumption of polymeric materials.

The processing of natural and synthetic polymers into useful products (fibers, films, and moldings, to name a few) involves many operations. These operations, now carried out on a large scale, have created unusual engineering problems.

The aim of this letter is to point out that most of the conversion operations are closely related and that they constitute a unified engineering specialty, referred to in this letter as *polymer processing* and for which we propose this definition:

Polymer processing is an engineering specialty concerned with operations carried out on polymeric materials or systems to increase their utility. These operations produce one or more of the following effects: chemical reaction, flow, or a permanent change in a physical property. Specifically excluded are the chemical reactions involved in the manufacture of resins.

This definition is reasonably specific and concise, but a too literal interpretation may lead to contradictions.

It is our intention to exclude from the field of polymer processing operations which are purely mechanical in nature, such as machining and conveying. It is, of course, true that practically any processing operation will cause physical or chemical changes in organic high polymers. However, under ordinary conditions these changes are so slight that they are not detectable and the terms *chemical reaction* and *permanent physical change* mentioned in the definition refer only to *those which are deliberately created by the operation*. For example, it is known that certain machining operations on solid plastics will cause internal stress relaxation. If the primary purpose of the machining operation is to produce stress relaxation and thus change certain physical properties, then the operation is part of polymer processing. Otherwise it is not.

In principle, polymer processing operations are closest to the chemical engineering unit operations. In practice, the unique properties of high polymers introduce complexities and difficulties demanding unusual techniques for their solution. For this reason it is useful to consider polymer processing as a field separate and distinct from the chemical engineering unit operations.

A few typical polymer processing operations falling within this definition are:

Injection molding; calendering; extrusion; sheet thermoforming; compression molding; flame treating of polyethylene; pigment dispersion and mixing in polymers; vulcanization of rubber; stretch orientation of fibers and films; welding of thermoplastics.

Injection molding is an example of a polymer processing operation that causes *flow* without effecting a permanent change in a physical property or a chemical reaction, aside from the slight

degradative changes occurring during the process.

Flame treating of polyethylene film is an operation of polymer processing producing *chemical reaction* but no flow. The effect of the chemical reaction is to change permanently the physical properties of the surface.

The stretch orientation of crystallites in nylon filaments is a polymer processing operation producing a permanent *change in a physical property* without chemical reaction or flow.

Pigment dispersion and mixing are operations of polymer processing if they are done in a polymeric medium, such as a molten plastic or a polymer solution, because they involve *flow*. Dry blending is mechanical in nature and does not fall within the scope of polymer processing.

Compression molding of thermosets involves both *chemical reaction*, which makes a permanent change in the physical properties of the material, and *flow*.

The vulcanization of rubber is one of the oldest polymer processing operations. It involves *chemical reaction* (cross-linking) in a polymer (rubber) and it produces a remarkable change in physical properties.

Polymer processing is *engineering* and its basic problem is one of analysis of operations. The preceding discussion shows that analyses of polymer processing operations must be based on concepts drawn from the following sciences: Rheology. Polymer chemistry. Heat transfer. Thermodynamics.

Rheological concepts are used to analyze *flow* in polymeric materials. The concepts of polymer chemistry provide the key to understanding the chemical reactions and the changes in physical properties occurring in polymers. Many polymer processing operations are controlled by heating and cooling rates. The sciences of heat transfer and thermodynamics enable these rates to be calculated.

E. C. Bernhardt, *Polychemicals Dept., E. I. du Pont de Nemours & Co., Wilmington, Del.*, and James M. McKelvey, *Chemical Engineering Dept., Washington University, St. Louis, Mo.*

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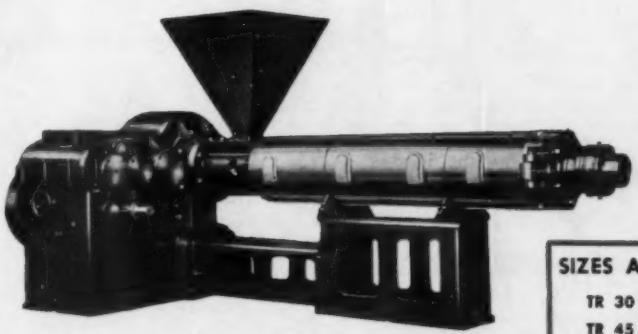

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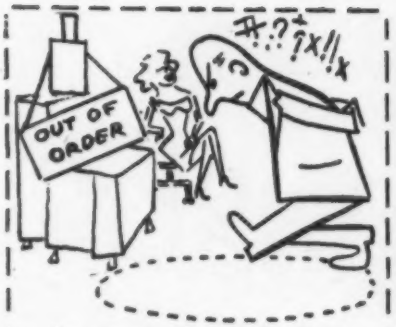

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Blow molded jar holds 6 oz. of shampoo in cream form; pastel screw-on cap is injection molded

Shampoo bottle of high-density polyethylene is shipped with molded dispensing cap, measuring cup

High-density polyethylene shampoo containers

The cosmetics field, in certain areas of which low-density polyethylene squeeze tubes and bottles have long found a fertile market, is now beginning to provide an outlet for the high-density material as well; this time not in the form of squeeze containers, but as a quality packaging medium with the functions of holding, conveying, and protecting the product.

Pioneering this new application is John H. Breck, Inc., Springfield, Mass., which has adopted blow molded thin-wall, high-density polyethylene bottles and jars for packaging its line of Banish shampoos.

The bottles, which hold 16 oz. of liquid shampoo and are intended for professional beauty shop use only, are made of 0.945 density polyethylene and are about 90% lighter than similar glass bottles.

The jars, which are retail items and contain 6 oz. of the shampoo in cream form, are made of 0.960 density material and also weigh about ⅒ as much as comparable opal-glass jars.

Despite their light weight, these thin-wall containers have sufficient rigidity for safe handling.

Tests reported by Breck indicate that the high-density material reduces liquid permeation by 50 to 85% over low-density polyethylene. In one series of tests high-density jars were cycled between 35 and 100° F. for 28 days with a net weight loss for the entire period of only 0.15 percent.

What are the advantages of the new containers in this application? In addition to the savings in weight—which range from 37 to 47% on the filled packages—the design potential offered by polyethylene and the protection it affords to the product were prime factors in Breck's decision to go to the material.

On the other hand, there are still two obstacles that must be overcome before use of high-density polyethylene in the cosmetics field becomes more widespread.

One is price. Compared with glass containers, the polyethylene package costs 20% more, even when allowance is made for savings in shipping resulting from lighter weight. Breck, however, anticipates that the containers will be more competitive with glass in the near future.

The other is a degree of consumer resistance to plastics as a prestige packaging material. But the properties of the new material should overcome most of that.

Credits: Containers blow molded by Plax Corp., Hartford, Conn., using Hercules Hi-Fax for bottles and Phillips Marlex for the jars.

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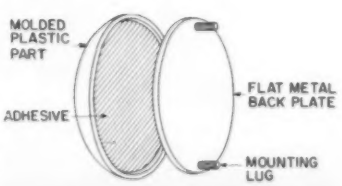
Adhesive-mounted medallions

Advantages of labor saving and inventory reduction are claimed for a new method of attaching molded plastics medallions or nameplates to a metal backing plate provided with built-in mounting lugs.

Developed by Erie Plastics Div. of Erie Resistor Corp., Erie, Pa., the process consists of bonding a recessed molded part to a flat metal plate with a tough adhesive. With this type of medallion, the end-user has only one part to handle rather than separate molded parts and metal escutcheons to hold them in place. This results in less labor time in assembly and half as many items to stock. The method also allows more freedom of design and application, according to Erie, since no lugs have to be molded into the plastic part.

In addition, ornaments mounted by the adhesive method are more resistant to adverse weather conditions, since the reverse side of the molded part is completely sealed by the backplate and adhesive. Further dividends are that pilferage is virtually eliminated because of the strength of the bond, and that the supporting and cushioning effect of the adhesive layer increases the impact resistance of the plastic molding.

The mastic attachments are cemented with a 100% solids polysulfide rubber adhesive.—END



Molded medallion is adhesive-bonded to metal backing plate

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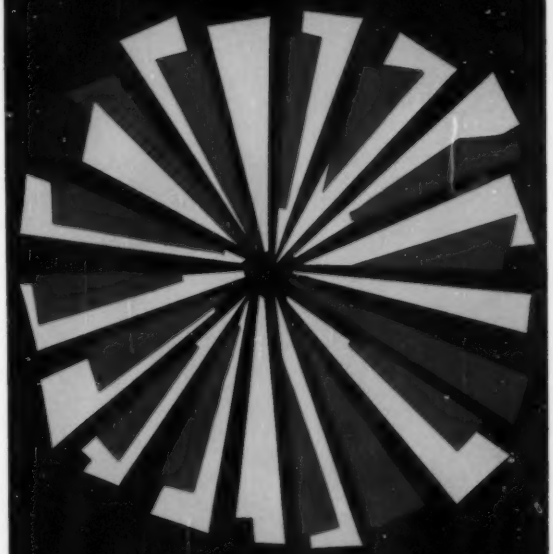

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Molded high-density polyethylene tote boxes are non-toxic, will not dent, stack easily, and are lower in cost than their stainless steel equivalent

Polyethylene tote boxes

An invasion of one of stainless steel's domains by high-density polyethylene took place at the recent National Restaurant Association convention. The item is an injection molded kitchen and dining room tote box for restaurants, cafeterias, and hospitals. The new box weighs only 33 oz. (compared with over 90 oz. for stainless steel), stacks easily, is made to fit standard carts, defies denting, is non-toxic, chemically resistant, takes cold storage to −100° F., and may be washed in standard restaurant dishwashing equipment.

Prices for standard stainless steel tote boxes are in the $12 to $13 range. The new high-density polyethylene box sells for $4.50 to $5.50, depending on quantity.

An important "plus value" was found in the reduction of noise. This was accomplished by eliminating the rattling of dishes against metal.

Credits: Tote boxes molded by Sinko Mfg. & Tool Co., Chicago, Ill., for Bloomfield Industries, Inc., Chicago, using Marlex high-density polyethylene from Phillips Chemical Co.

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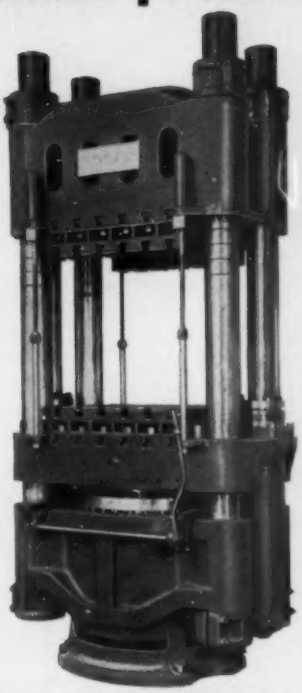

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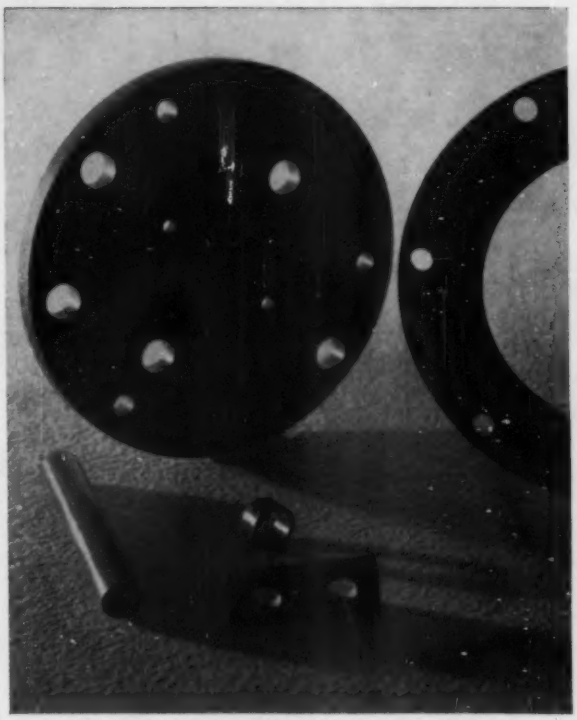

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"Stained glass" window at University of New Hampshire, Durham, N. H., is part of 24-panel window wall. Painted black lines simulate lead of real stained glass windows. (Photos, Monsanto)

Modern "stained glass" windows

A simple and economical way to make permanent "stained glass" windows of laminated safety glass has been developed. The new technique, which involves the use of three interlayers of polyvinyl butyral film, could largely replace a conventional manufacturing process that is more than one thousand years old.

First step of the process in making a window consists of painting the design on the surface of one pane of glass. Then three layers of tough polyvinyl butyral sheeting are sandwiched between the decorated glass and a sheet of unpainted glass, and the assembly of five layers bonded under heat and pressure. At the end of this operation the design is permanently sealed into the laminate.

Laminated safety glass conventionally has only one plastic interlayer, but in the decorative variety, two extra thicknesses are added to "cushion" the unevenness resulting from the painted areas.

This simple 2-step process of painting and laminating can be contrasted with a 14-step operation of cutting, waxing, firing and leading that is required to make real stained glass. The process affords the artist versatility, since he does not have to work with many small pieces of glass.

The paints used in the decorative windows were specially developed for the application. They are non-fading, compatible with the plastic film, and capable of withstanding the high laminating temperatures.

Credit: Polyvinyl butyral interlayer and special paints supplied by Monsanto Chemical Co.

Designs are painted on inside surface of glass prior to lamination

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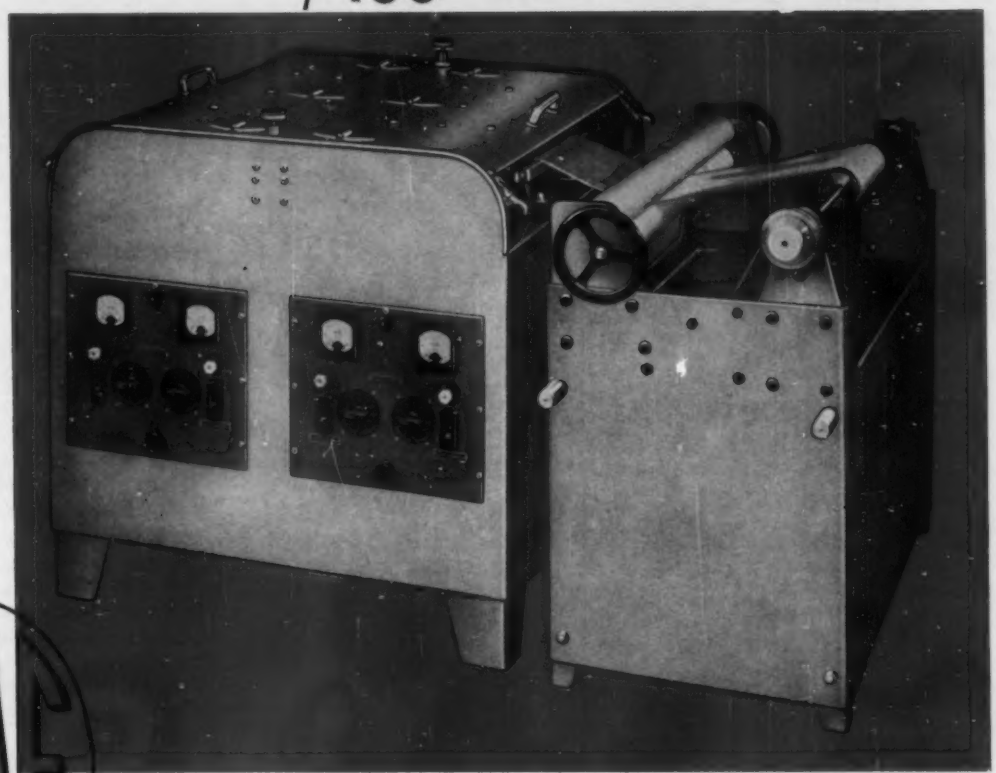

MODEL BT/103 ELECTRONIC MACHINE with TAKE-UP MODEL S. Equipped with two intensity generators for electronic pre-treatment of film 15.75 in. wide, and for passage of bobbin film 39.37 in. wide at speeds up to 150 ft./min. Machine pre-treats polyethylene bobbins from both sides. It can also be easily adapted to pre-treat films 31.50 in. wide.

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by WALTER D. PAIST
Celanese Corp. of America
Newark, N. J.
1958, 288 pages, $5.75

The purpose of this new book is to present a clear, concise story of the applications of cellulosics based on their properties. It cites as many examples as possible of uses which have proved successful. A general introduction precedes the chapters on chemistry, general properties, and fabrication. These are followed by the applications—twelve general categories of them that include the important examples. An appraisal of the industrial future of the cellulosics completes this outstanding survey.

2 FLUOROCARBONS
by MERRIT A. RUDNER
Enflo Corporation
Maple Shade, N. J.
1958, 256 pages, $5.75

This is the initial book on the fluorocarbons, and it completely covers their properties, chemistry, processing and fabrication techniques, and final applications. It also demarcates the efficient use of these materials by describing their capabilities and limitations as compared with other plastics. Sufficient case histories are offered to emphasize the benefits derived from the fluorocarbons in solving a materials problem. The electrical, mechanical and chemical applications are clearly described, and future applications discussed from the standpoint of present trends. The book abounds in helpful charts, tables of processing data, and illustrations.

and don't forget...

3 PLASTIC SHEET FORMING
by ROBERT L. BUTZKO
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1958, 192 pages, $4.50

4 POLYAMIDE RESINS
by DON E. FLOYD
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Minneapolis, Minn.
1958, 240 pages, $4.50

5 POLYURETHANES
by BERNARD DOMBROW
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Versatile new reinforcing paper

A cross-creped paper is making news in the plastics industry. X-Crepe is the name of the product produced by Cincinnati Industries, Inc., Cincinnati, Ohio. Through a patented process, smooth kraft is bound on a drum, creped diagonally, bound again on another drum and cross-creped. The result is a product which is claimed to have many of the characteristics of cloth and is made in a variety of types and sizes.

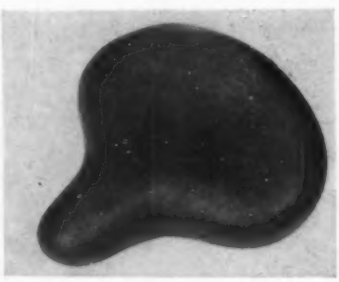
This basic material can be used as a resin-impregnated core stock in laminated plastics, or as a "plumper" or backing material for films. It can be laminated to films and can be used as a "base" fabric on which thermoplastics may be cast-coated. It is claimed to take any embossed pattern or design desired.

Unlike cloth, the new material stretches in every direction. Since it has no warp or woof, it can be slit, die-cut in any shape, or fed off rolls into high-speed machinery. It won't ravel. Yet it has "hand" and a cloth-like feel. It is pliable and formable. It can be sewn.

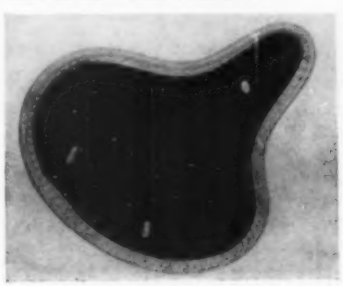
Since the material may be saturated, but not overloaded, with resin, it is starting to be used as a laminate base with phenolics, melamines, and epoxies for post-forming applications, in which it can be molded or drawn into three-dimensional shapes with compound curves. Coated with or laminated to vinyl, it becomes an upholstery fabric.

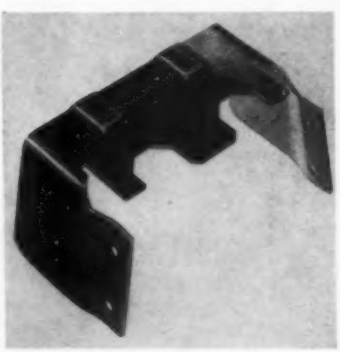
One unusual application was found in bicycle seats. Custom-stitched bike saddles were demanded for the same price as unstitched saddles. However, the saddles have a metal core and it was impossible to stitch vinyl-coated fabric to the metal. A multi-ply grade of X-Crepe was recommended as a possible solution. It worked and is now in use as an undercovering for the saddles. Die cut sheets of this material, vinyl-coated fabric and padding are all laid into a forming press with the pre-formed metal core. All are then stamped together to form a sandwich. The creped undercover and vinyl fabric are then stitched together and trimmed in one operation. A final stitching puts an attractive binding around the edge of the bicycle seat.

The makers are hopeful that the new laminant will bring new production economies to more end products using plastics.—END



Bicycle seat is produced with undercovering of cross-creped paper and vinyl-coated fabric top. Paper, padding, and fabric are laid into forming press with preformed metal core and stamped together to form a sandwich. Undercover and vinyl fabric are then stitched and trimmed





Compound-curved industrial laminate is produced by the postforming of resin-saturated cross-creped paper

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On delivering their *fifteenth* NRM, a 6" model shown being received at Maynard Plastics, we asked officials about their experience with NRM Extruders. We were pleased, but not surprised at the enthusiasm of their reply . . . "Our NRM's are operated 24 hours a day, year in and year out," said Maynard Axlerod. "Extrusions quality and precision are of the highest, yet maintenance requirements are low. We are particularly pleased with the dependability of the thrust bearings," he added. "In eight years of operation, and with a steadily increasing number of NRM machines, we've had *no thrust bearing failures.*"

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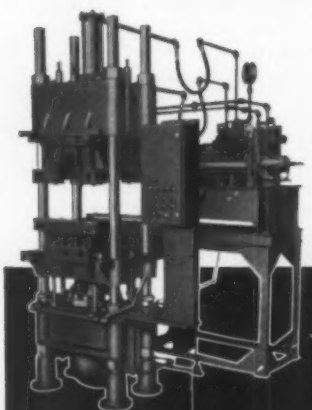

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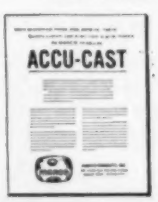

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Housewares

(*From pp. 75-79*)

baskets," states Mr. Barnett. "In order to make plastics acceptable to the majority of people, decorations will be refined and highly styled. . . . We believe that the incorporation of various materials such as wood, cork, and metal will increase in our industry, as we mature and allow our thinking in design to progress and keep ahead of trends."

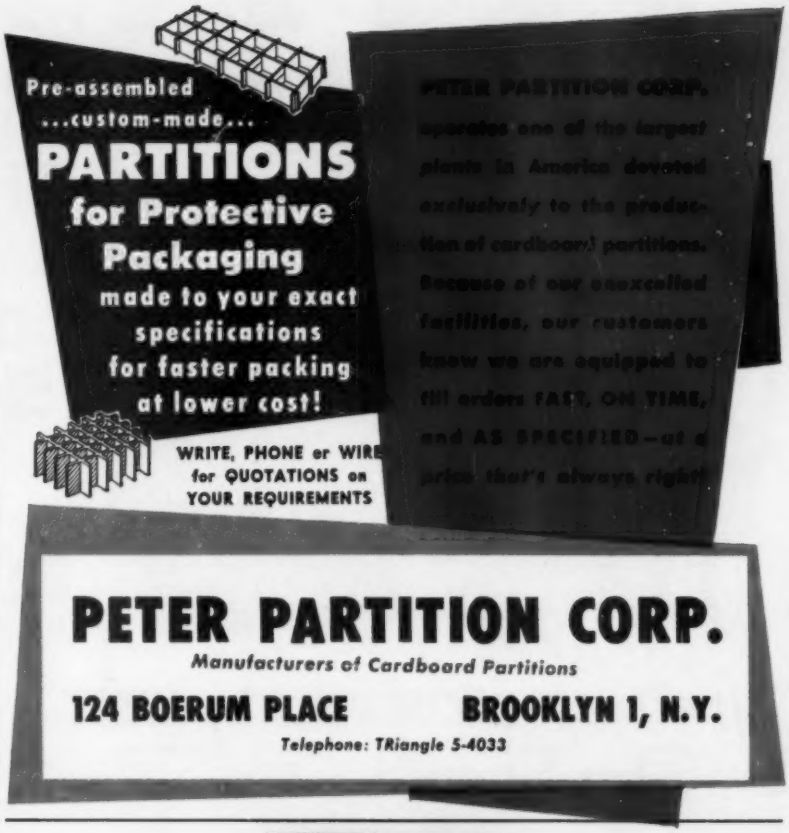
Rise of "big ticket" items

Certainly a major development in plastics housewares is the growing emphasis on "big ticket" items retailing at from $3 up. Probably the first items to touch off this trend were wastebaskets, dishpans, and mixing bowl sets. These were rapidly followed by completely new king-size products such as trash containers, clothes baskets, and clothes hampers. Some of these items contain several pounds of molding material and retail for as much as $10 to $15.

Improved plastics materials, larger equipment, and refined production techniques paved the way to these large housewares products. To a limited degree, thermoforming of sheet stock has also entered the picture. A case in point is a laundry and utility basket of styrene alloy, produced on a continuous extrusion-vacuum forming setup by Hamilton Plastics, Inc., Chicago, Ill. This part measures approximately 19 by 25 by 6¾ in. deep. For certain types of housewares having a relatively simple design, thermoforming offers many interesting possibilities in relatively low mold cost, rapid tooling time, and the excellent physical characteristics that are inherent in the finished products.

Labeling, packaging, merchandising

Progressive upgrading in labeling, packaging, and merchandising has helped bring plastics housewares to their present degree of public acceptance. The rise of rack merchandising, used in some 85% of the nation's supermarkets, has highlighted the fact that today's housewares must lit-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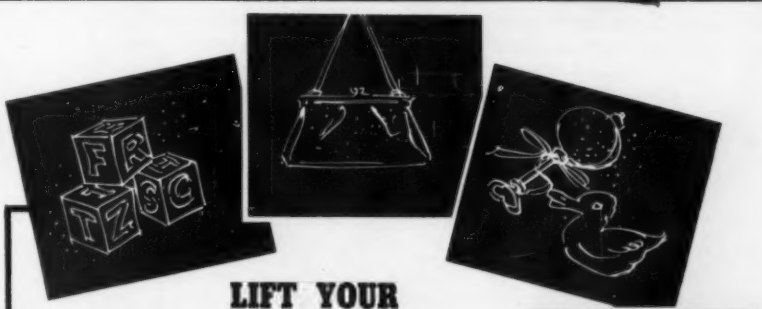

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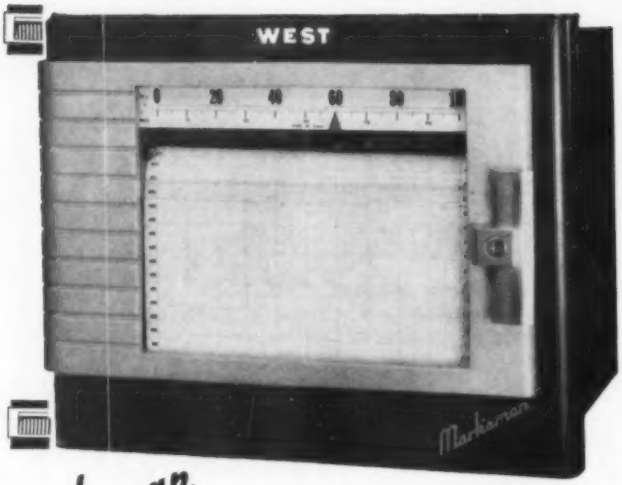

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erally sell themselves through effective packaging and display. The American Rack Merchandisers Institute has a tough but realistic policy on new items: either they move off the shelves after a fair trial period, or they are dropped. Only sound products that are skillfully packaged and displayed can meet this acid test.

Also important in stimulating better packaging and labeling of plastic housewares is the annual Informative Labeling Contest staged by The Society of the Plastics Industry, Inc., which covers housewares and nine other product categories. The aim of this competition is to encourage participation in S.P.I.'s continuing informative labeling program. Thanks largely to this campaign, today's housewife can shop much more intelligently for plastics housewares than was the case a few years ago.

Judges who selected the winning entries in the latest S.P.I. informative labeling competition made a number of constructive suggestions which should lead to better merchandising of molded plastics housewares and related products. They recommended, for example, that the word "plastic" should be emphasized on the label, and that the specific type of plastic be named. Information such as sizes, capacities, etc., molded directly into certain housewares items, they pointed out, would insure that this information would not be lost to the user, even after removal of the label. In the opinion of the judges, it is a distinct advantage to include "caution" or "warning" statements on labels where necessary.

Despite rapid progress, the plastics housewares industry is still faced with such problems as design piracy, the maintenance of quality standards, and what some operators consider unfair price competition.

"Competitive conditions," states Joseph L. Sholkin, president, Beacon Plastics Corp., Newton, Mass., and chairman of the S.P.I. Housewares Manufacturers' Div., "have unfortunately increased some undesirable practices. This, I believe, delays the progress that

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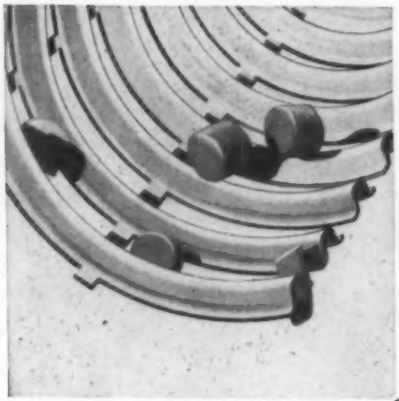
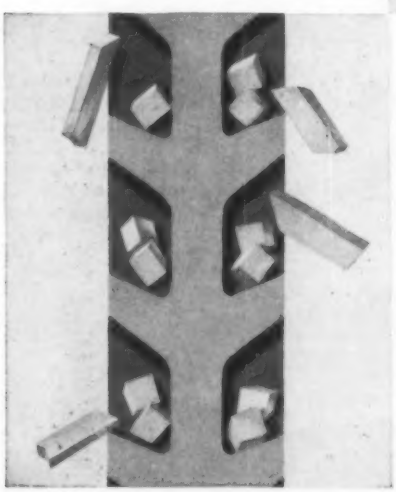


CARTER GRADERS PERFORM THICKNESS, WIDTH SEPARATIONS

For sizing or separating free-flowing granular materials by *thickness*, Carter Precision Graders use revolving cylinders with *slotted perforations at the bottom of grooves*. Saddles between these grooves upedge the materials presenting them to the slots in an edgewise position. The thinner pieces pass through and the thicker pieces pass over and are conveyed to the end of the machine.

For *width* sizing or separating the Precision Graders use revolving cylinders with *round recessed perforations*. The recess causes the materials to be presented to the round perforations in an upended position. Narrow pieces pass through and wider pieces pass over for discharge at the end of the cylinder.



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Carter Disc Separators contain a series of discs mounted on a revolving horizontal shaft. Each disc has hundreds of undercut pockets which select or reject plastics or similar materials according to *length*. As the discs revolve through a mixture of materials, the pockets lift out the shorter pieces. The longer pieces, too long to be held in the pockets as they rise, drop away from the discs.

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could be made in our industry if such practices and general instability were corrected. . . . We are still maintaining the stable pricing and selling policies. . . . We are also realistic, offering some of our accounts periodic monthly specials. However, at a time when the housewares industry is being generally downgraded we are preparing a line of better quality to be merchandised on a somewhat different basis, which will be released the first of the year."

Says J. B. Mockenhaupt, vice president in charge of sales for the housewares division, Tri-State Plastic Molding Co., Chicago, Ill.:

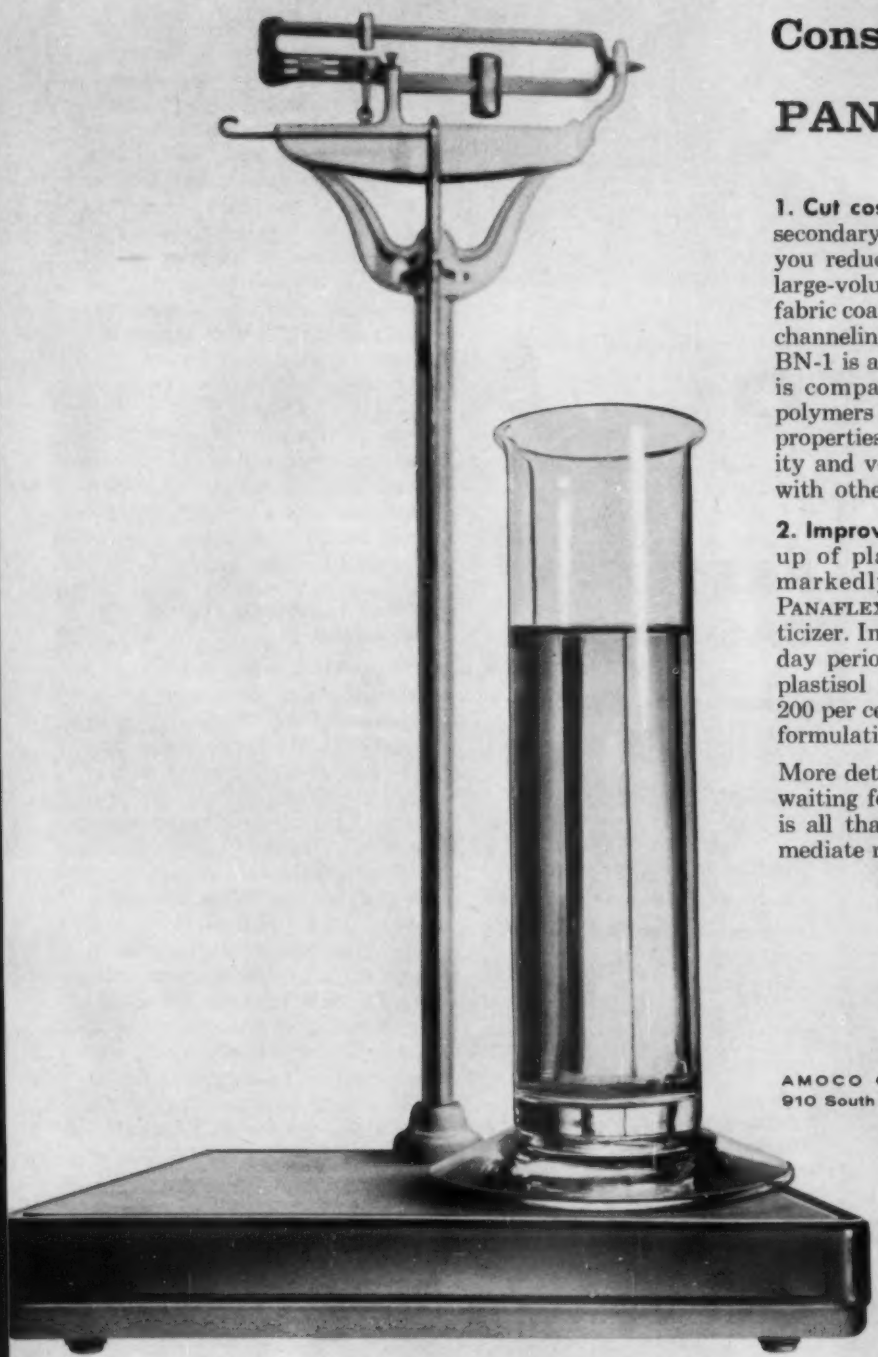
"We feel very strongly that the continued growth of the plastics housewares field is directly dependent upon a most serious appreciation of the need for better design, better quality, more effective use of color, better packaging and labeling. Somehow—someway—all entities of distribution must be made to realize that an otherwise glorious future for plastic housewares will be sabotaged unless 'price' is subjugated to the necessity for legitimate profit to the manufacturer—as well as sufficient margins to provide the necessities for successful merchandising."

In this year of profit squeezes, belt-tightening, and business soul-searching, what is the long-term outlook for plastics housewares?

"While business generally throughout the industry is rather spotty," said Mr. Sholkin recently, "most housewares manufacturers like ourselves sincerely believe that this is a temporary condition and that the sales curve will continue upward as it has in the past. Many of us are expanding plant facilities. . . . We have purchased additional equipment and have acquired more warehousing space to handle what we expect to be an increase in business."

Problems still remain to be solved, but the plastics housewares industry has come far in a relatively short period. And if Mr. Sholkin's forecast is correct, the future of this dynamic industry looks mighty promising indeed.—End

Anybody looking for a way to reduce plastisol costs? Consider PANAFLEX BN-1



1. Cut costs. PANAFLEX BN-1 is a secondary plasticizer that can help you reduce costs, especially in such large-volume, low-cost applications as fabric coatings, jacketing, cushioning, channeling or gasketing. PANAFLEX BN-1 is a hydrocarbon plasticizer. It is compatible with vinyl chloride polymers and copolymers. Electrical properties are excellent. Color stability and volatility compare favorably with other hydrocarbon plasticizers.

2. Improve stability. Viscosity build-up of plastisols during storage is markedly reduced by the use of PANAFLEX BN-1 as a secondary plasticizer. In one stability test over a 50-day period at 115° F., viscosity of a plastisol with PANAFLEX BN-1 was 200 per cent less than a straight DOP formulation.

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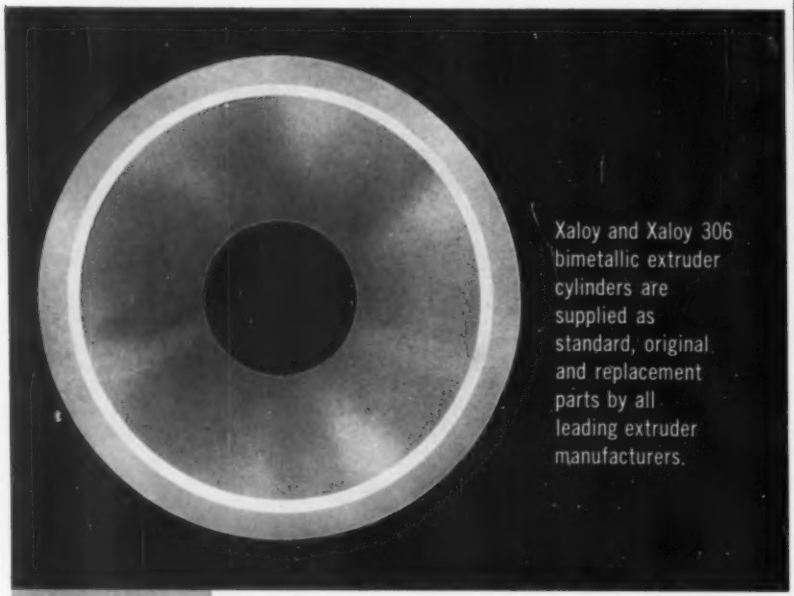

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Art laminates

(*From pp. 92-93*)

for shaping the laminate pieces to their final dimensions.

At this point the work was turned over to Formica's model shop where a skilled technician cut, assembled, and cemented the pieces of laminate to a plywood backing to produce the finished mural. A total of 288 pieces were used.

Costs are high

Although no exact figures are available, cost of this piece of art—not counting the artist's compensation—is estimated in excess of $500. Model and machine shop time accounted for the bulk of the cost. To some degree, of course, the permanence and ease of maintenance inherent in the material can help justify the high cost. However, the company undertook the job as an experiment (it's the first such mural ever made) and to promote the use of laminate art. It also points out that fabricators can make laminate art economically—although less elaborately—by cutting decorative laminate sheets to various shapes and setting these pieces together on wall applications.

Other techniques less expensive

Several other forms of laminate art have been developed by the Decorative Art Dept. Their cost is considerably lower than that of the mural described above; however, the exact figures will depend on the type of work requested.

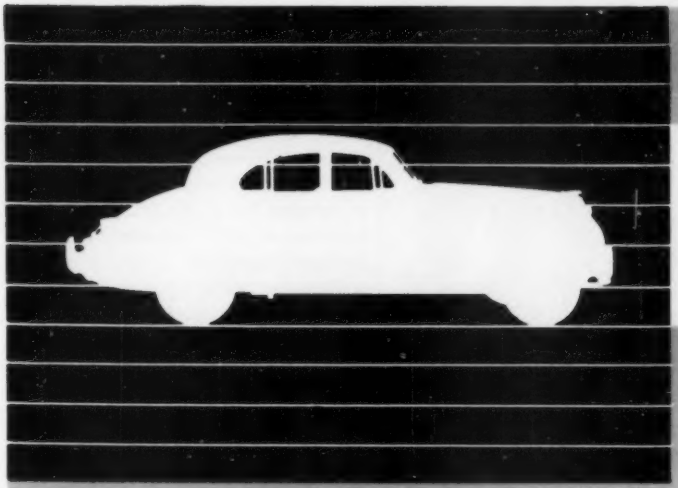
Three processes are used:

1) Inlay—in which decorative sheets of melamine-impregnated paper are cut to desired shapes and laid into the laminate prior to the final pressing operation.

2) Artlay—a silk-screen method for laying special patterns and designs into the laminate; this is particularly effective when small, repetitive themes are involved.

3) Painting—in which, using specially developed inks, a picture is painted on the decorative paper before lamination.

Several installations of laminate art are illustrated in the photographs on page 93.—END



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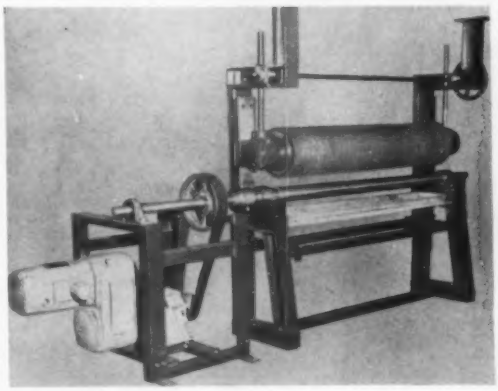

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Automatic molding

(*From pp.* 104-108)

related with evaluations on production molds, are the only satisfactory methods so far found to develop these very necessary properties in phenolic materials, because of their complex, heterogeneous nature.

Resins must have a fast, fluid melt and harden rapidly to a non-tacky and somewhat resilient state. An extremely hard final set is undesirable; this can cause sticking in deep slots and blind holes in the mold, where it is difficult to polish thoroughly and provide necessary taper.

Proper lubricants are even more important. The old standbys that have been used for years—the stearates and mineral and vegetable waxes—are still effective. In addition, a great many new synthetic lubricants have been evaluated, and some of these have proved quite useful.

It will be obvious to experienced molders that a clean, well-polished mold, with adequate taper, is necessary for good mold release. Hard chrome plating, while not an absolute necessity, is certainly desirable. In spite of all the work done on automatic molding materials to develop good mold release properties, no lubricant or resin system has yet been devised that will completely offset the effects of dull, pitted, scored, or oxidized mold surfaces.

Rigidity on ejection

Automatic molding places a new premium on rigidity of ejected pieces because of the short cycles used. Though phenolics become more rigid as final polymerization progresses during curing, none are completely cross-linked in the mold on the fast cycles used today. However, to be suitable, the material must, nonetheless, be sufficiently rigid at ejection to avoid distortion, warpage, and excessive shrinkage on cooling.

Proper rigidity on discharge from the mold and good mold release go hand in hand; they are practically opposite faces of the same coin. If rigidity is poor, mold release will frequently be troublesome, although this is not

invariably true. Small parts of simple cross-section may eject easily from the mold, in spite of a rubbery set, but then take on the appearance of one of Salvador Dali's limp watches on cooling.

Final polymerization rate of the resin is the most important factor in affecting this property. The addition of mineral fillers during compounding helps, but to a lesser degree.

Various tests have been developed for this property. Guzzetti (2) made an elaborate study of it and calculated an "apparent modulus of elasticity" for a variety of phenolic formulations.

We use a simple, quick test in which the deformation of the base of an inverted A.S.T.M. cup, molded at 325° F. is measured by a dial micrometer, when subject to a fixed load of 5750 g. imposed for 15 sec., immediately after molding. Jost (3) has described a similar simple test that is made on a 4-in. disk.

Carried out at various cure times and correlated with tests in production molds, this has proved to be a useful development and control test.

Uniformity

The importance of uniformity, of minimum batch-to-batch variation, hardly needs elaboration here. It is not enough that a material do a good job in an automatic mold in initial trials or with the first few shipments; it must maintain that performance. Uniformity, like liberty, is the reward of vigilance, of careful supervision, of good process control in resin manufacture, compounding, and blending, to ensure that the properties originally developed in the formulation are maintained in day-to-day production.

References

1. Borro, E. F., "Advances in thermoset molding," MODERN PLASTICS, *33*, 145, May 1956.
2. Guzzetti, A. J., "Measurement cure rate of thermosetting molding materials," ASTM Bulletin #220; 57, Feb. 1957.
3. Jost, H. D., "New methods for testing hot rigidity of molded phenolics," Plastics Technology, 551, July 1957.

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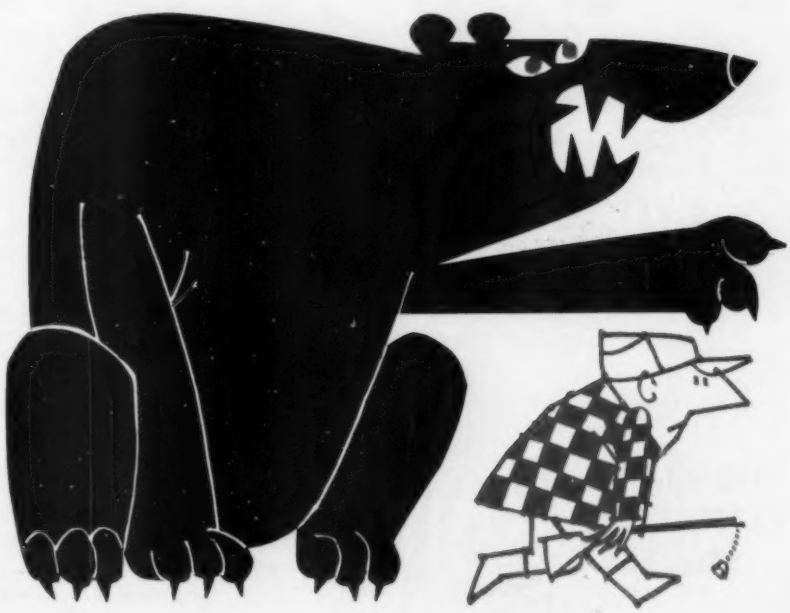

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Odor	Neutral
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CENTRIFUGAL AIR SEPARATOR. 4-page illustrated leaflet discusses features of a materials separator for removal of fines as they are produced by the mill. Unit handles wood flour, soya flour, silica sand, etc. Includes operating information and specifications. Universal Road Machinery Co. **(G-810)**

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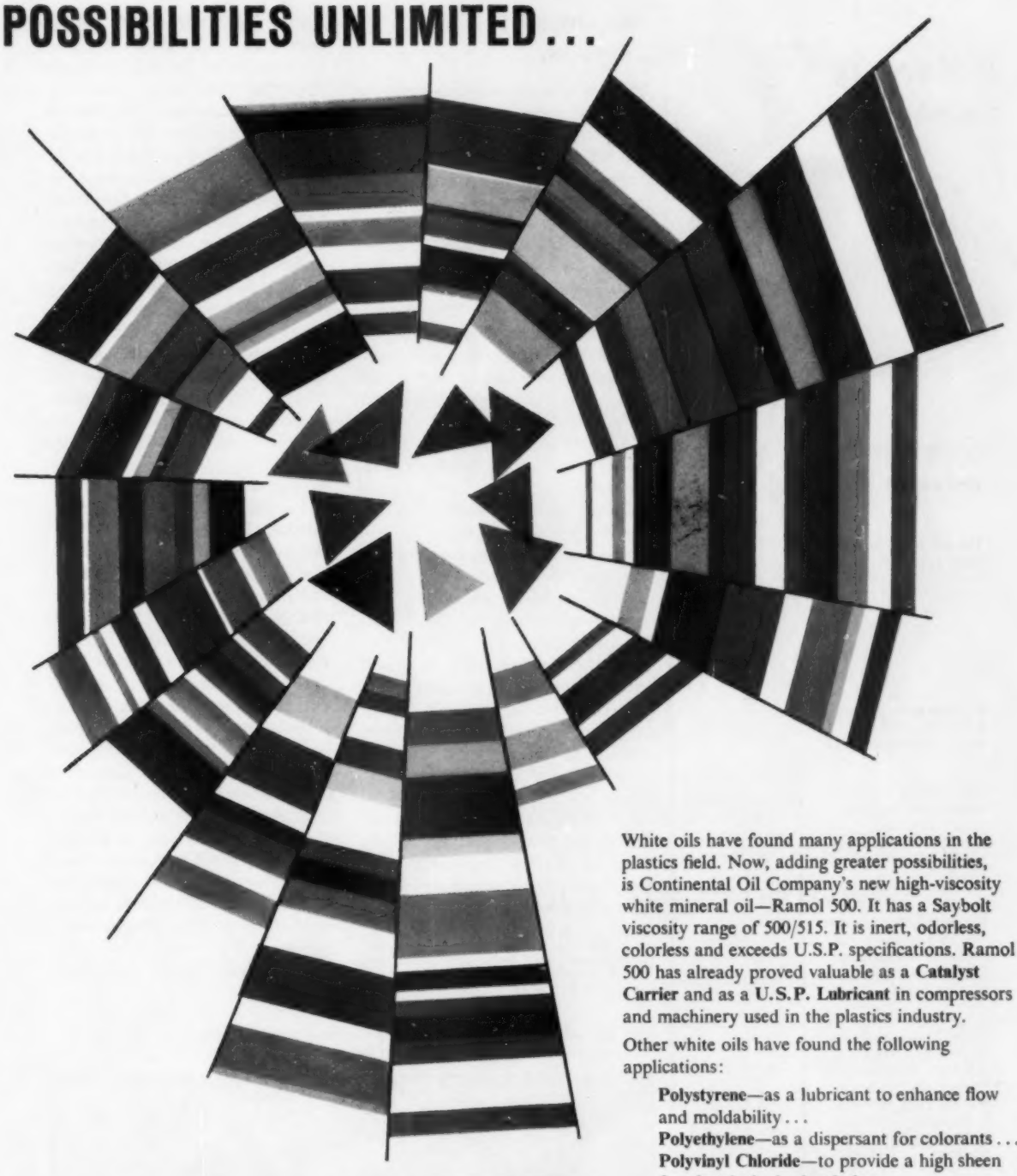

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Moisture

(*From p. 109*)

chanical pumps enable systems to exhaust water vapors, but the huge vapor load still causes extended pump-down times. A super-refrigerated cold trap, from which condensables can be removed, provides an obvious answer, but the difficulties associated with cold traps have prevented their wide acceptance in industrial operations. The operating temperature should be about −150° F., which rules out conventional mechanical refrigeration units or dry-ice-and-solvent mixtures. Liquid nitrogen gives acceptable performance, but is expensive, not widely available, and hazardous.

Traps, even of high capacity, become loaded and must be defrosted. When exposed to the interior of the chamber they rapidly accumulate large amounts of ice and the system must be shut down to defrost them.

A new NRC system, designed to overcome these troubles, consists of a refrigerated coil placed between the high-vacuum valve and the diffusion pump[1]. It is installed by bolting in an adapter flange at this point. Cooling is supplied by a recently developed, low-temperature, packaged cooler of sufficient capacity to reduce the temperature of the coil to −150° F. quickly, and keep it there, insuring fast pump-downs regardless of the ambient humidity.

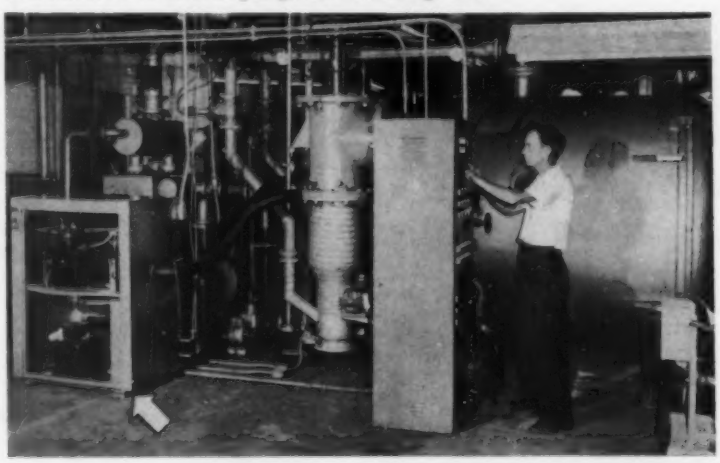
In operation, the unit condenses moisture only when the high-vacuum valves are open; the coil is bypassed during the "roughing" stage that reduces pressure to 200 microns. This eliminates the rapid icing-up that occurs when cold traps are exposed to atmospheric air. The reduced vapor loading makes it possible for a 4-hp. cooling unit to service the two 16-in.-diameter diffusion pumps normally used with large coaters. Defrosting, when necessary, is done by shutting down the refrigerator. The vapor from the defrosted ice passes through the diffusion pump into the gas-ballast pump, which exhausts it to the atmosphere.[2]

A typical installation of this system (Fig. 2, below) has been in operation for several months at Kent Plastics Corp., producers of metallized plastics name plates and medallions. The new cold-trap assemblies have been installed on three model 3124 NRC vacuum metallizing units. Reduction of pump-down time and rejects have not only saved money but have made Kent's production schedules virtually independent of plant humidity. The refrigeration unit can be operated round-the-calendar for less than $500 per year. Liquid nitrogen—used when humidity was bad—cost some coaters $1500-$2500 a year, depending on the weather.—END

[1] A similar system with about the same performance has been announced by F. J. Stokes Corp. (see p. 142).

[2] The details of this system were described in Chem. Eng., 80, Jan. 27, 1958.

Fig. 2: Compact refrigeration unit (arrow) can be installed at any convenient location near pumps of metallizing unit



Soviet science

(*From pp.* 111-118)

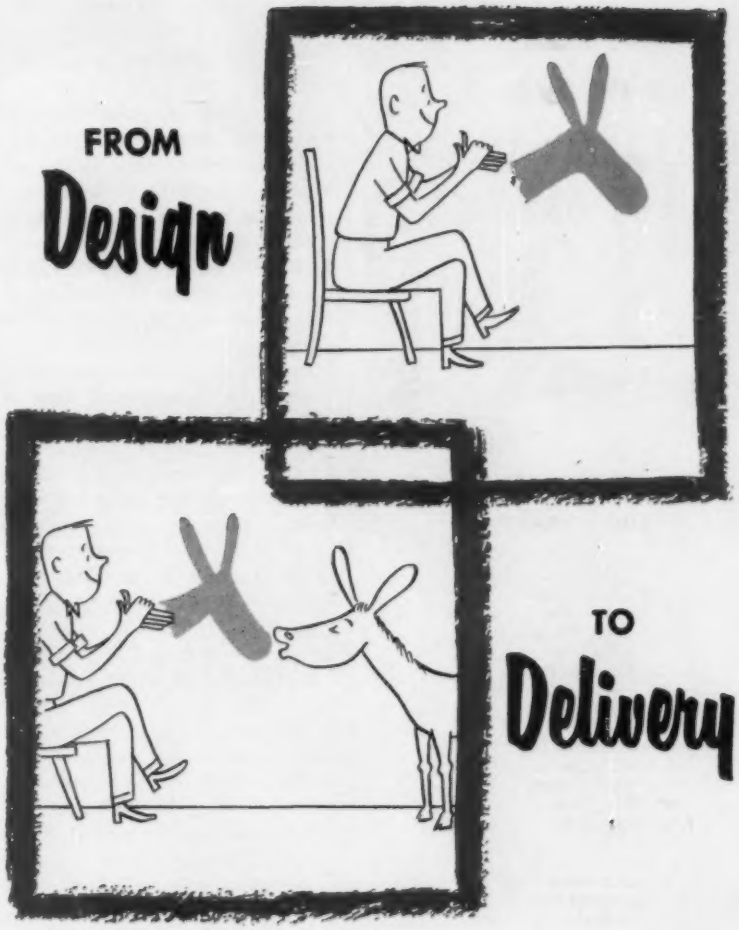
centrifuge and electrophoresis cell.

Prof. M. W. Volkenstein, top theoretician of the Institute and well-known specialist in the theory of polymer solutions and rubber elasticity, is using polarized infra-red to follow the processes occurring during the stretching of polymers; among other effects it was found that alpha gutta-percha is transformed into the beta modification at elongations above 100% and returns to alpha on relaxation, showing that mechanical stress can produce reversible changes in the conformation of macromolecules.

The introduction of optically active groups such as 1-menthyl, as substituents of linear polymers, particularly polyacrylates and methacrylates, is used as a tool to explore the local mobility of macromolecular chains. Optical activity is very sensitive to environmental changes and in fact, it was found that the presence of small amounts of swelling agents or crosslinking affects the optical activity of the substituents along the chain more than it influences other measurable properties. Also at the glass point a substantial change of the activity can be observed. Measurements of the rate and degree of crystallinity of various rubbery polymers are studied with X-rays, infra-red, and nuclear magnetic resonance, for which very modern and exceptionally precise instruments are available.

Stereospecific effects

Prof. Korotkov is studying the polymerization of various dienes with alkali metals and alkali organic compounds, a field which he entered many years ago and in which he and Prof. B. A. Dolgoplosk have developed a remarkably fine touch in the choice of the alkyl part of the catalyst and of additional complexing agents (ethers, alcohols, etc.) to perform certain stereospecific effects in the resulting polymer such as all 1,4-cis, all 1,4-trans, and all 1,2-addition, together with normal copolymers and block copolymers



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of these different species. Recently these studies have been expanded on the polymerization of acrylic and methacrylic acid derivatives.

While ionic polymerization in anhydrous systems has priority, other synthetic work is by no means neglected. Prof. Dolgoplosk has worked out a practical method to prepare 2-ethyl and 2-phenylbutadiene and is studying the properties of polymers of these units and of copolymers of them together with other monomers, including block copolymers of isoprene and styrene. One of these teams works on new redox systems for emulsion polymerization and has found that dihydroxy-maleic (or fumaric) acid is an unusually good reducing agent partner for hydroperoxides in aqueous phase and for peroxides in organic solvents. Such combinations are still active at temperatures as low as −20° C.

Korotkov's Institute is by far the largest existing research organization in the polymer field which selects its problems essentially according to their fundamental interest, has distinguished specialists for every branch of the field, and is amply equipped with all necessary instruments and auxiliaries. It has already contributed substantially to the progress of polymer science and there is a good prospect that it is going to move to a more and more leading position as time permits the full use of its many facilities.

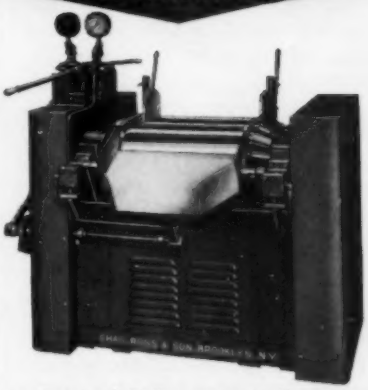
The Lebedev Institute of Synthetic Rubber Research, a large complex of relatively old buildings situated in a suburb of Leningrad, is under the directorship of Prof. I. W. Garmonov, who administers the research of six departments, headed by Profs. J. J. Poddubri, B. A. Dolgoplosk, A. L. Klebanski, S. A. Subbotin, and M. S. Nemtsov, and is staffed with about 100 graduate research fellows and 500 other employees.

Isoprene polymers

Much attention is focused on the polymerization and copolymerization of isoprene in emulsion with various vinyl monomers and still more on the corresponding reactions in anhydrous sys-

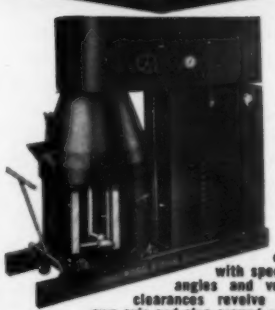
(*To page* 186)

NEW ROSS HIGH SPEED THREE ROLL MILLS WITH— ONE POINT HYDRAULIC ROLL ADJUSTMENT



- Pressure indicating gauges provide greater ease in properly setting rolls, and less skill or experience is required by operator.
- Roll pressure settings can be recorded for exact reproduction of material assuring standardization of product.
- Special equalizers assure positive parallelism of roll faces at all times for uniform dispersions and minimum maintenance costs.
- Mills have quick roll release with safety overload feature, and are convertible for either fixed or floating center roll operation. 2½x5, 4½x10, 6x14, 9x24, 12x30, 14x32, and 16x40" sizes.

Production size dispersion type Change Can Mixers with— DOUBLE PLANETARY stirrer action.



- Stirrers with special blade angles and very close clearances revolve on their own axis and also around can, developing 12 intense compressive and shearing actions with each revolution to break down and disperse agglomerates.
- Variable speed for infinite range of stirrer speed control. • Simplified vertical hydraulic lift for greatest ease in cleaning down stirrers. • Non-revolving can is completely enclosed during mixing for safety and to reduce solvent loss. Cans can be jacketed or fitted with slide gate when required. Cans are easily positioned or removed from Mixer.
- Extra heavy construction and standard type motor eliminate costly downtime. Oversized motor drives can be provided for kneading and mixing extremely heavy materials. 1, 2, 3, 4, 6, 8, 12, 25, 50, 65, 85, 125 and 150 gallon sizes.

Area of can contacted by stirrers during only one revolution of stirrers around can (2 seconds). Position of stirrers advances 4½° with each successive revolution to sweep entire area and all points on sides of can. Stirrers overlap each other as well as center of can.

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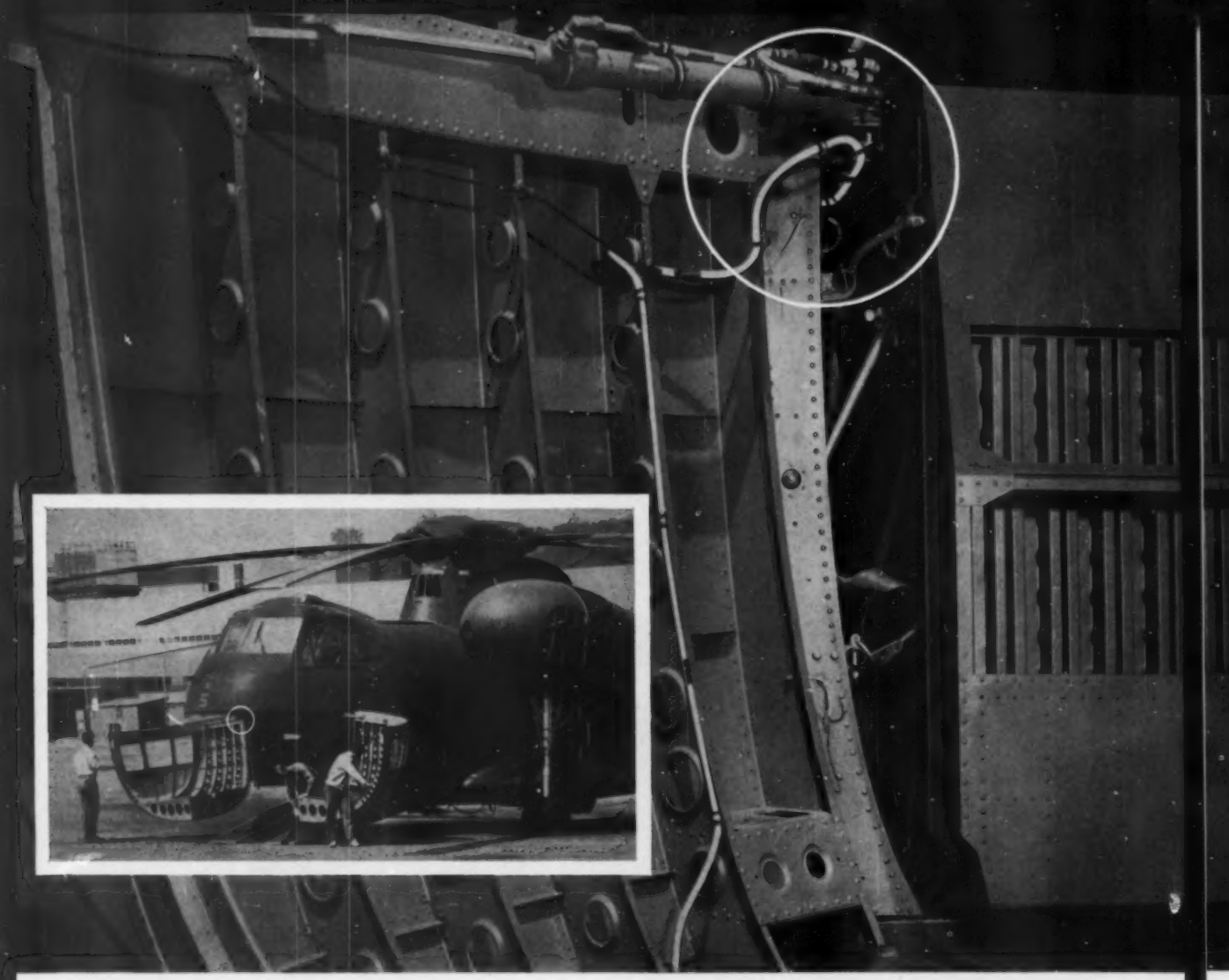


Photographs by Sikorsky Aircraft

Heat is high, space is limited, bends are sharp in today's complex electrical systems. In the S-56 helicopter, for example, cables snake through engine compartment, squeeze by cherry-red manifolds, loop over hinges to reach landing lights in clam shell doors. For this and comparably destructive environments, wire makers seeking to develop vinyl insulation with appropriate properties in thin section need better heat stabilizers . . . stabilizers with excellent dispersion, improved moisture resistance . . . stabilizers that provide greater volume resistivity, greater insulation resistance.

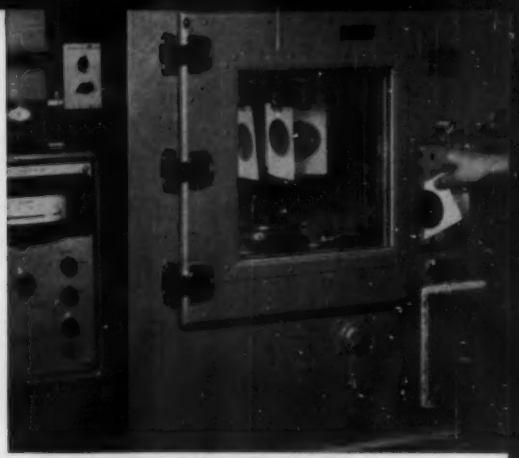
Dutch Boy® stabilizer research vinyl insulation tougher, more

These photographs show how National Lead research helps vinyl producers in one field . . . electrical insulation . . . overcome difficult stabilization problems and so broaden the market for their products.

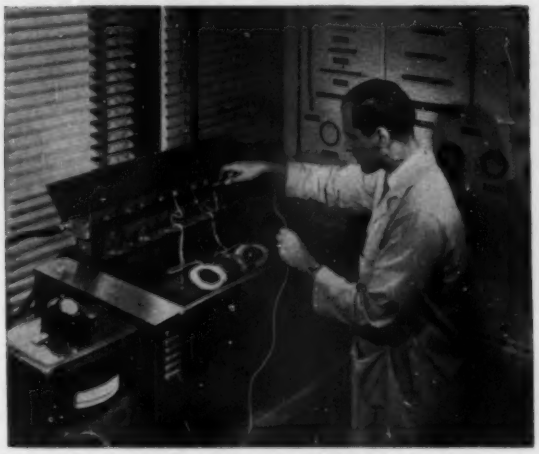
National Lead researchers do as much and more for producers of many additional vinyl products. Recently, for example, they came up with "Dutch Boy" stabilizer, Temex 3. This unique stabilizer provides both stabilizing and chelating action . . . greatly aids performance of vinyl flooring. Eighteen other "Dutch Boy" stabilizers boost the life or improve the usefulness of other vinyl products.

Get acquainted with useful, versatile "Dutch Boy" Chemicals. Write for handbook.

Researcher looks for tell-tale white in colored sample of proposed insulation. In this test, National Lead technician confirms that "Dutch Boy" stabilizer recommended for customer's proposed new thin vinyl insulation disperses properly. Improper dispersion would be signalled by white specks on background green of sample. Excellent dispersion is a principal reason for the wide use of "Dutch Boy" stabilizers when vinyls undergo very high heat in process or use and when maximum available stabilization action is needed.



Oven separates "men" from "boys". In this oven, researchers age various insulation compounds at slightly above service temperatures. Then they condition the compounds for one hour at 95°C and, at the same temperature, measure their volume resistivity. Aim of test is to determine compounds that will maintain maximum electrical resistivity. In the run shown above, "Dutch Boy" Dythal® stabilizer gave best results. This stabilizer does well in 8-mil, 105°C wire.



Immersion proves "Dutch Boy" stabilizer resists water and protects insulation. Using standard Underwriter's procedures, National Lead technicians put a customer's experimental high temperature insulation through water-immersion test. Commercially extruded wire is tested in 50 to 500 foot lengths. It must go weeks at voltage, show less than 10% resistance loss from all causes . . . including water absorption or scoring of thin coating by oversize particles that might have stuck in die. When properly stabilized with "Dutch Boy" stabilizers, thin stocks pass this test easily.

Insulation breakdown test at ½ of service thickness completes tests. After determining the most suitable stabilization for a proposed compound, National Lead is sometimes asked to run an insulation breakdown test. For this test, lengths of wire are produced by the customer with the insulation at ½ service thickness. Here you see a run in progress on 8-mil, 105°C stock protected by Dythal stabilizer. Better performance than ever before is now being obtained in thin, high temperature compounds. With further research, still higher values are expected.

helps make thin heat resistant

7 "Dutch Boy" stabilizers meet most vinyl insulation needs. Each of these products of National Lead research is a commercially proved product. Among them, you'll find the right stabilizer for all electrical and a variety of other opaque vinyl products.

Tribase* (Tribasic lead sulphate)	For high heat stability in vinyl electrical insulations.
Tribase E* (Basic lead silicate sulphate complex)	An economical stabilizer for vinyl electrical insulation.
Lectro "60"* (Lead chlorosilicate complex)	Low vol. cost stabilizer for electrical insulation.
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Dythal® (Dibasic lead phthalate)	Outstanding stabilizer for 105° C — class insulation.
Dyphos® (Dibasic lead phosphite)	Outstanding anti-oxidant; heat, light and weather stabilizer.

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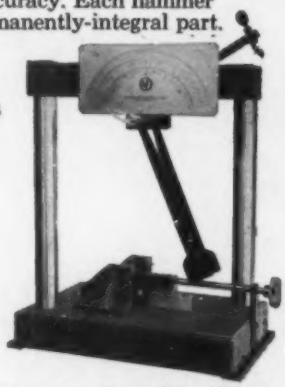

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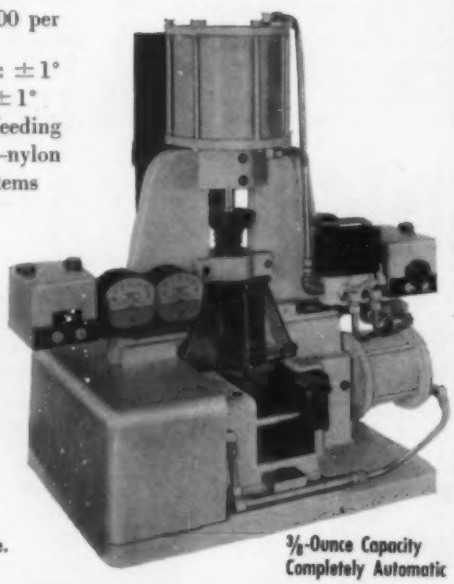

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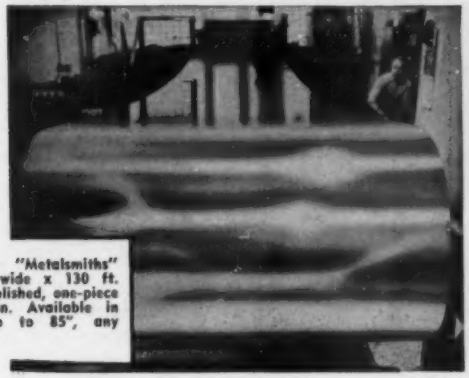
tems with Ziegler catalysts, Li-alkyls, and alfin type complexes. Profs. Klebanski and Dolgoplosk, who also work in Korotkov's Institute, have developed various stereospecific species of isoprene polymers, including a material which appears to be a block copolymer of the 1,4-cis and 1,4-trans species, has a low initial modulus, shows rapid reinforcement through crystallization, and ends up with a very high tensile strength in the fully extended state (about 4500 p.s.i. at 1000% elongation).

A group of several research associates investigates the merits of copolymers of isoprene with acrylic acid, methacrylic acid, and maleic derivatives. Introduction of carboxyl groups to the extent of 1.25 to 3.5% leads to tacky, snappy rubbers which have improved solvent resistance and can be cured with MgO, ZnO, and other bifunctional basic ingredients.

The study of the detailed structure of the various polymers and copolymers and the establishments of their mechanical, thermal, and electrical properties is in the hands of Profs. Poddubri, Subbotin, and their coworkers, who have at their disposal the necessary arsenal of instruments for the establishment of solutions and properties, and for the testing of rubber samples in the various stages of manufacturing.

Summarizing the result of the visits to the research institutions in Moscow and Leningrad, it would seem that basic polymer research is carried out in this area by 30 to 40 scientists of professorial rank, 350 to 400 Ph. D. coworkers, and about 1000 laboratory assistants. Other smaller centers of polymer chemistry and technology are in Baku (ethylene, propylene, styrene), Tashkent (cellulose), Charkov (vinyl and acrylic compounds), Sverdlovsk, Kazan, Kiev, and in the newly developing scientific and technical areas of Novosibirsk and Irkutsk. In all these locations there are apparently another 30 to 40 professors, 250 to 300 Ph. D.'s, and about 1000 helpers engaged in basic research in the synthesis of macromolecules and their applications.—END

Cut Production Costs With
CONTINUOUS BELT PROCESSING
of laminated work—sheets—film—coatings, etc.



Shown is "Metalsmiths" belt 57" wide x 130 ft. long, in polished, one-piece construction. Available in widths up to 85", any length.

Many advantages are gained by using "Metalsmiths" endless belts in processing work. It improves and speeds up heating, cooling, conditioning and setting. Highly polished surface provides automatic contact gloss. Adapted to many special requirements.

"Metalsmiths" Stainless Steel (18-8) belts are available in any length and extra wide sizes. One piece, no center seam, polished or unpolished, width and camber controlled. Consult our engineers. Metalsmiths, 558 White St., Orange, N.J.

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Your guess is as good as the next as to *what* that strange looking object is. But chances are – if it's molded of polyethylene, Interplastics had a hand in it!

Whenever *your* next polyethylene product is ready to move from the drawing board to the production line, it'll pay you to check with Interplastics. We probably can save you money with carefully processed polyethylene, natural or colored. Sometimes we have attractive spot lots of virgin polyethylene, too.

But that's not all—Interplastics also deals in polystyrene, nylon, acrylics, vinyl and cellulosics. And —if you have scrap or surplus materials for disposal, we would like to buy it.

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OUR ONLY FUNCTION IS TO SAVE YOU MONEY

profiles in plastics

by **B. FRANK HANTZ,** *Vice President*
AMERICAN INSULATOR CORPORATION
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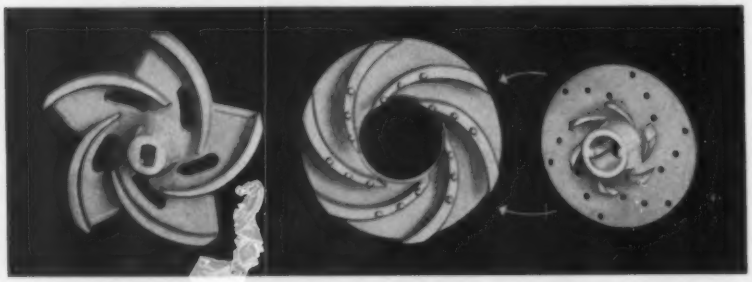
"Aico's enviable position in the field of molded plastics has been attained largely through customer satisfaction and service. Since 1916, Aico has been a major supplier of molded plastics to many of America's pace-setting industries. Each molding job presented its own unique problems . . . problems which were successfully solved by the integrated facilities and coordinated skill of expert craftsmen within the Aico organization. Perhaps the best proof of Aico's efficient service . . . and satisfaction delivered . . . is the record of new assignments we receive from customers we've served in the past."



MOLDED NYLON PUMP IMPELLERS ANOTHER NEW USE OF AICO PLASTICS

These nylon pump impellers are typical examples of how better products result from the use of Aico Molded Plastics. Molded to extremely close tolerances, providing precision accuracy without machining, the nylon impellers reduce assembly costs while increasing pump efficiency. Their light weight conserves driving energy. The chemical, corrosion and wear resistant qualities of the nylon material promises longer impeller life and less pump maintenance. Aico Molded Plastics can give your products new, *impelling* sales advantages, too. Discuss them with Aico now.

FREE Plastics Designer's Handbook

Shows how good design controls unit cost of molded plastics. Molded plastic parts with a low unit cost can be achieved only when the practical limitations of die-making are given full consideration when the part is being designed. Aico has prepared a Plastics Designer's Handbook that tells and illustrates how costly design errors can be avoided. A FREE copy is yours on request . . . use coupon below.

AICO'S Nook of Plastics Knowledge

INSERTS . . . may be used in plastic parts as fasteners, to support loads, simplify handling or facilitate assembly. (They may serve functional purposes or may be used purely for decoration.) Smooth rod inserts (see sample above) may be securely anchored by bending, splitting, notching, swaging or knurling. Other types of inserts are fully covered in Aico's booklet "Good Plastics Design Makes Cents." Coupon will bring your FREE copy.

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A completely integrated plastics molding service with unmatched experience and coordinated facilities for Engineering, Mold Building, Compression, Transfer, Plunger, Injection and Cold Molding plus the molding of Reinforced Fiberglas.

AMERICAN INSULATOR CORPORATION
New Freedom, Pa.

Please send me a FREE copy of Aico's PLASTICS DESIGNER'S HANDBOOK.

Name _____

Title _____

Company _____

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Behavior of PVC pipe

(*From pp.* 120-128)

procedure showed at least 20% diametral expansion but lower bursting pressure than observed in the other burst tests. It was found by prolonging the test time that bursts occurred at much higher expansion than for quick tests; the lower results for the A.S.T.M. tests may be explained on the basis that leakage of the pressure fluid occurred somewhat before the "true ultimate" pressure was reached and thus, in effect, since these tests last for several minutes, pressure creep-rupture tests rather than conventional burst tests were being conducted.

Burst-test results from the room-temperature tests are shown in Table II, p. 125. A discussion of the calculated burst-test results is given later.

Short-time burst tests with water as the pressure medium were also conducted on 2-in. Schedule 80 PVC pipe at temperatures to 150° F. The results obtained from three tests at each temperature are plotted in Fig. 2, p. 126. Photographs of pipe burst at different temperatures are shown in Fig. 3, p. 128.

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• • •

Part II of "Creep and stress-rupture behavior of rigid PVC pipe" will be published in the August issue of MODERN PLASTICS.

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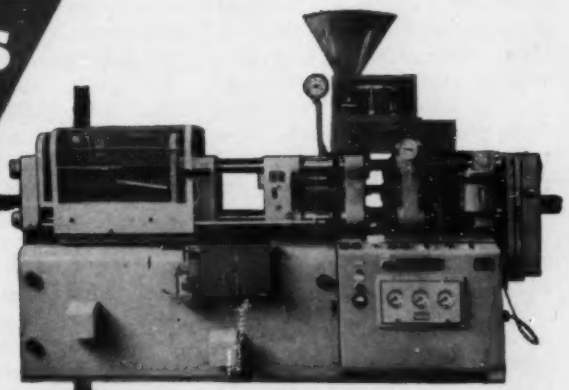

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are well known all over the world. Their extraordinary mechanical advantages are their fully automatic operation, their simple electro-chemical design and their complete reliability in continuous service.

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 (*Section 1 starts on p. 37*)

Polystyrene film in 1- to 2-mil gage

An oriented, breathable, unmodified, unplasticized, uncoated polystyrene film will go into production next January at The Dow Chemical Co.'s new Cleveland plant. Known as Trycite, the new, clear, crisp, fresh-looking film will be available in thicknesses of from 1 to 2 mils. The future looks promising enough for Dow to announce that expansion of the new plant is already under consideration. Present supply of the film is extremely limited. A possible market of anywhere from 20 to 100 million lb. is envisioned in the foreseeable future.

Plans that are expected to broaden the versatility of Trycite film envision a coating process that will improve its barrier properties (gas) and make it heat sealable. Presently, it is sealed with an emulsion, solvent, or latex type adhesive; a vinyl acetate emulsion type has proved exceptionally satisfactory. The film doesn't take up moisture from an adhesive and consequently does not curl or ripple.

Further expansion plans for Trycite include possibilities for thicker film and sheet.

Good aging properties. Shelf life or indoor aging properties of polystyrene film are claimed to be exceptionally high. Thus Christmas goods, which are made eight to ten months before market time, can be packed in Trycite without fear of hydroscopic problems or loss of luster in the wrapper, according to Dow. The film takes up almost no moisture at all (0.7%). Up to 185° F. there is no shrink.

Printing on this film requires careful watching, as like other oriented films it is sensitive to drying temperature. But even though cost of printing may be higher than on cellophane, the printed film is still claimed to be less costly than printed cellophane. Alcohol-type ink used in flexographic printing can be used. No treatment is required before printing and register is excellent since there is no stretch.

Bags are now made from Trycite with glue sealing or a mechanical crimp seal, with heat sealing a future possibility. Hosiery, handkerchiefs, rubber bands, and paper products are reportedly already on the market in Trycite film bags. Overwraps are expected to become practical later on, with various types of adhesives used. An overwrap over a tomato tray is a promising possibility.

Envelope windows. Best known use for Trycite up to now is in windows for envelopes where its low cost and clarity is a dominating feature. Window boxes for packaged goods is the next big target. Polystyrene film is not as tough as polyethylene, but it withstands a straight punch remarkably well and doesn't break easily. Its clarity, sheen, grease resistance, and balance of w.v.p. with gas permeability make it ideal for such products as bacon. Western-Waxide is already producing such a package.

*Reg. U.S. Pat. Off.

How big is urethane?

Since urethane production began in this country about five years ago, predictions about its potential volume have always been big and always sharply divergent. Now that the industry is established, raw material suppliers still differ not only about the future size of their business, but also disagree on actual production figures for 1957.

National Aniline Div., Allied Chemical Corp., and Mobay Chemical Co., two major suppliers of isocyanates, have just taken stock of the industry and announced their findings. Joseph Marzak, manager of market research at National Aniline, stated that over-all consumption of flexible urethane foams increased to 12 million lb. in 1957. He added that "this figure will double in 1958 and will possibly go to 70 million lb. in 1960."

On the other hand, James D. Mahoney, Mobay's general sales manager, estimated that 15 million lb. of flexible and 2 million lb. of rigid urethane foam were produced in 1957, and that the potential for 1958 is 47 million lb., of which 4 million lb. will be rigid or insulation foams. Du Pont, another producer of isocyanates, estimates 18 million lb. of flexible foam and 2 million for rigid in 1957.

Mr. Marzak estimates that "this year's consumption of flexible urethane foam by the automobile industry should reach 7 million pounds." But Mobay's forecast is 9.5 million lb. for this major market which, according to Mr. Mahoney, consumed 3 million lb. in 1957 for crashpads alone.

All companies are optimistic about the potential in the bedding and furniture fields, and Mobay feels that its 1957 estimate of 2 million lb. for furniture and 1 million lb. for mattress pads will grow to 20 million lb. in 1958. Mr. Marzak declared that "it is believed that the development of molding techniques will lead to large-volume consumption of urethane foam in pillows." Few people in the industry would disagree about the potential volume for this application, but foam makers are divided about the economics of molding urethane foams, and many feel that fabricated slabstock will capture this market.

In support of his over-all figures, Mr. Mahoney itemized estimated consumption in other fields

News about R&A SINCE 1913 **Adhesives**

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New "quick-grab", soft seam adhesives for flexible plastic foams

- *Yield bonds of "tearing strength"*
- *Set rapidly for swifter mass production*
- *Brush smoothly for lower labor costs*
- *Travel further for lower cost-per-unit*

While there is no "universal" adhesive for every type of application, our new BONDMASTER® R275 appears to be "the" answer for foam-to-foam bonding.

This new adhesive features as soft and dimple-free a seam as you've ever seen, and a "tearing bond" on all brands of flexible urethane and rubber latex foams.

What's more, current users report these added time-labor-and-cost-saving benefits: "It grabs faster – we can turn over the cushion sooner without it falling apart" . . . "It seems to coat without penetrating – we use less" . . . "It doesn't run off the brushes – cleaner to work with".

Mass-production bonding of urethane foam to carpeting demands a quick-drying, flexible, non-staining, machinable adhesive.

FOAMS TO FABRIC, WOOD, METAL

For foam to fabric, to wood, to metal, to carpeting, to you-name-it, we've a wide range of other "chemical fasteners" developed for specific applications.

BONDMASTER R328T seems to be the favorite for bonding urethane foam to fabric or to wood. BONDMASTER G527 is specified for sound-deadening foams by a leading equipment manufacturer. Our R203 features extremely fast drying solvents for instantaneous bonding of fabric reinforcing tape to foam seats in automotive mass production.

We've a non-staining adhesive for vinyl foams – BONDMASTER R294 – that withstands drycleaning in Stoddard and other naphtha cleaning solvents.

And, of course, the first practical rapid-tack-loss, one-part, fast-grab, soft-seam adhesive for foam rubber – BONDMASTER R225, developed by R&A in 1947 – is still the leading formulation used in that industry.

Tell us about your specific problems so we can send samples of the adhesives most efficient for the materials you are working with.

Part of the problem is that they're so versatile . . .

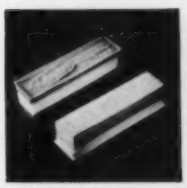
. . . flexible urethane and vinyl foams, we mean.

They're being used in so many different products in so many different ways . . .

And must withstand so many different types of service conditions in end-use . . .

. . . that a "universal" adhesive just "cannot be". (Some bonds must be flexible, others rigid, for example.)

For instance . . .



Urethane foam to itself . . . to foam rubber . . . to wood . . . to rigid styrene . . . to cardboard . . .

You can, however, have one single source of supply if they are equipped to serve you with "families" of adhesives, custom-tailored to each specific type of end-use. As were the BONDMASTER adhesives used in the products shown on this page!

R&A SINCE 1913

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The Plastiscope

as follows: 1 million lb. used for packaging in 1957 should reach 2.5 million lb. in 1958; carpet underlay is expected to climb from 1 million to 3 million lb.; and miscellaneous uses, such as sponges, mats, and wall tiles, which consumed 7 million lb. in 1957, may increase by another 1 million lb. this year.

Total isocyanate consumption, according to National Aniline, was 6 million lb. in 1957, may reach 12 million in 1958, and will continue upward into the 40 to 50 million-lb. range in 1960. Mobay did not specify actual amounts but announced that its sales figures are 70% ahead of last year's.

Although it would be misleading to compare the poundage of isocyanates with the volume of liquid coatings for wiring, leather, textile treatment, and industrial maintenance (because isocyanate content varies enormously in formulations for different applications), projected growth in this field shows some measure of agreement between the two companies. Mr. Marzak states that consumption this year will be around 300,000 gal. and in 1960 it might reach 3 million gallons. A spokesman for Mobay estimates that consumption of "urethane resin materials for surface coatings" (isocyanates and reactive materials such as polyesters, castor oil, etc.) will reach 1 million lb. this year and can triple in each of the next two years, thus reaching 9 million lb. in 1960.

Regarding the future of urethane-type synthetic rubber, Mr. Marzak termed the industrial goods market "the best candidate for near-term commercial success." Other companies estimate a market of upwards of 750,000 lb. for urethane rubber in 1959.

Better distribution

Improvement in the distribution of plastics sheet so that small users may purchase material with the same facility and choice as large-scale users is emphasized by the recent announcement that Commercial Plastics & Supply Corp. has become an authorized distributor of Bakelite's vinyl film and sheeting. Commercial claims to be the largest distributor in the East and addition of the Bakelite line gives the firm complete coverage of the plastic sheet industry. Bakelite products stocked by Commercial will include rigid or unplasticized vinyl sheet, flexible film in rolls (Krene), and cast vinyl film used for seat covers and other protective applications. Commercial maintains sales offices in Miami, Fla.; Pittsburgh, Pa.; Greensboro, N. C.; and Newark, N. J. Its headquarters are at 630 Broadway, New York, N. Y.

This move follows closely upon an announcement that Cadillac Plastic & Chemical Co., Detroit, Mich., is now handling Mylar film in gages from ½ to 10 mil and flat polyethylene tubing in all gages and widths from 3 in. to 16 feet. Cadillac will invest $575,000 this year in new buildings and equipment and $250,000 more in warehouse stock. The company is also increasing by 40% its facilities for extrusion of methacrylate and polystyrene sheets, rods, and tubes. Cadillac officials state that the firm now serves more than 25,000 active accounts.

Celastic Corp. to be sold

Du Pont and United Shoe Machinery Co., joint owners of Celastic Corp., Kearny, N. J., have signed an agreement to sell that company to Wasco Chemical Co., Cambridge, Mass. The 33-year-old company, with manufacturing operations at Du Pont's Arlington Works in Kearny, produces Celastic colloid-treated fabrics used in the shoe industry, building construction, the boat and marine industry, and in the manufacture of displays, etc.

Wasco is engaged in the development and manufacture of plastics for the construction industry as well as in the production of acrylic sheet. The company plans to expand the production, uses, and distribution of Celastic in areas where Wasco is already active and in fields which are yet to be explored.

Wasco maintains plants in Cambridge, Mass.; Sanford, Me.; Van Nuys, Calif.; and Toronto, Ont., Canada.

Oneida in melamine dinnerware

New entrant in the melamine dinnerware field is Oneida Ltd. Silversmiths, Oneida, N. Y. Market studies have been completed by the company and specifications are now being developed for the necessary machinery, tools, and dies.

Oneida's entry into this field is part of the firm's diversification program which was begun in 1955 and will not affect its continued production of sterling, silverplated, and stainless flatware and hollow-ware.

New phenolic resins

Five new phenolic molding compounds have been announced by Loven Chemical of California, Newhall (L. A. County), Calif.

Alcylite PG 001 is an improved general-purpose compound for compression or transfer molding. Molded parts are said to be suitable for use at temperatures up to 300° F. PG 001 is designed to meet the requirements of MIL-P-14D, Type CFG and MIL-P-10420, Class 2 specifications.

PH 001, a heat-resistant compound with good molding properties, is reinforced with fibrous glass. Heat distortion temperature is above 300° F.

PM 002, PS 002, and PM 003 are high-impact molding powders. PM 002 is a two-step nylon flock-filled molding powder said to have good electrical properties. It is reported to have a heat distortion point of 250° F., but in classified applications the compound has withstood higher temperatures for short periods of time. This product has some inherent flexibility and an impact strength of 0.65 ft.-lb./in. of notch. Molded parts have low specific gravity (1.22).

PS 002, a high-impact compound containing a non-corrosive flame retardant, is designed for aircraft pulleys and

U.S.I.

Vol. III No. 3

POLYETHYLENE PROCESSING TIPS

HOW TO AVOID WRINKLING IN EXTRUSION OF BLOWN TUBING

Wrinkles in blown polyethylene tubing on the windup roll is a problem that plagues even the most experienced extruders. It occurs intermittently in almost every shop, and may usually be avoided by one or more of the following measures.

Die Adjustment

Be sure the die opening is adjusted properly. If it is out of alignment, it can cause gauge variations which result in an uneven pull at the nip rolls and subsequent wrinkling on the windup. Uneven or thin gauge at the sides of the ascending tube may show as chevron-type wrinkles on the edge of the roll.

The improper adjustment of the die opening or orifice, or a frost line which is not level, may cause a condition known as bias — a greater or smaller distance around one half of the tube than around the other half — and results in a surplus of film to the front or rear on the windup. Ruffle-like wrinkles across the center of the lay flat width are characteristic of a bias condition.

Film Temperature Control

If the frost line is too high the blown tube is difficult to control and may cause poor gauge control around the circumference of the tube and uneven gauge in the film. This in turn could lead to an unbalanced pull in the nip rolls or across the collapsing guides and result in wrinkling. The frost line can be lowered by slowing down the rate of extrusion, reducing melt temperature or increasing cooling.

If the film is too cold when it reaches the nip rolls, it may be overly stiff and subject to crimping. The temperature may be increased by increasing the screw speed, lowering the height of the rolls or stepping up the extrusion and take-off rates. Temperature increases must be made cautiously, though, to avoid blocking of the film.

Adjustment of Guides and Rollers

The ascending tube may wobble from side to side due to extruder surging or rapidly moving air currents in the shop. It is recommended that the tube be supported by horizontal stationary guides at two or three places during its ascent.

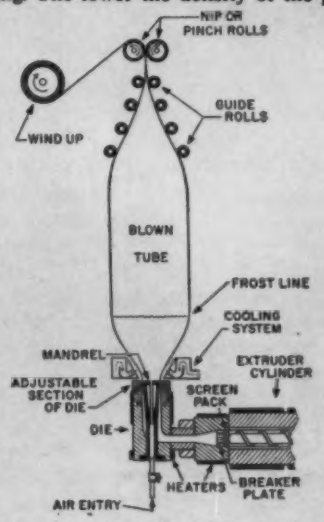
Slight eccentricities in alignment of the nip rolls may be the underlying cause of wrinkles. These rolls must be parallel to insure uniformity of pressure. It is recommended that the rear nip roll be fitted with small hydraulic cylinders to provide positive pressure across the entire width of the nip rolls.

Wrinkling may also occur if the collapsing guides or rollers are not properly aligned with the nip rolls. Many commercial windups contain adjusting knobs for shifting the front to rear position of the collapsing rollers slightly.

Considerations of Gauge, Width, Resin Density

Wrinkling is more prevalent at low gauge and high take-off rates, and precise gauge control becomes even more important. At film gauges below one mil extremely close control of the above factors must be maintained to avoid wrinkles.

Narrow tubing has less tendency to wrinkle than wide tubing. The lower the density of the polyethylene resin used to make the blown tubing, the less susceptible it is to wrinkling because it has more flexibility — will conform more readily to a flat shape.



Technical Help from U.S.I.

As you can see, wrinkling of blown tubing is a problem with many possible causes and solutions. U.S.I. technical service engineers have worked closely with many extruders in tracking down sources of difficulty and suggesting preventive measures. They would be pleased to work with you on this or any other processing problem.

U.S.I. manufactures a variety of film-grade resins meeting the highest and most diverse specifications for clarity, gloss, toughness, stiffness and slip. We would be glad to work with you in determining which PETROTHENE® resin best fits your needs.

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comparable applications where a strong, non-combustible product is required. Impact strength is said to be 2.0 ft.-lb./in. of notch; heat distortion temperature, 310° F. This compound is designed to meet the requirements of specification MIL-P-14D, Type CFI 20.

PM 003, a sisal reinforced compound, is distributed at general-purpose prices in contrast to conventional impact resistant products. According to the company, it can be molded on standard equipment to produce pulleys, meter housings, and automotive parts. The compound is said to have an impact strength of 1.4 ft.-lb./in. of notch and a heat distortion temperature of 300° F.

Wood flour

Clear white pine flour for use as a low-cost replacement for alpha cellulose in urea formaldehyde, melamine, and other plastics compounds is available from the Wilner Wood Refinery, a Div. of Wilner Wood Products Co., Norway, Me. The soft wood flour is claimed to be super-refined, to possess exceptional purity and uniformity, and to cut filler costs drastically without sacrifice of properties.

Red pigment

A new family of red pigments with lightfastness and other properties which make possible durable red shades for plastics, automobile finishes, paints, fabrics, inks, and other products has been developed by Du Pont. A new unit has been constructed at Du Pont's Newport, Del., plant for making these Monastral pigments.

French firm licensed

United States Rubber Co. has exclusively licensed Société d'Electro-Chimie d'Electro-Metallurgie et des Acieries Electriques (UGINE), Paris, France, chemical manufacturer, to produce its Kralastic high-impact plastic materials and Paracril oil-resistant synthetic rubbers in France under patents which U. S. Rubber holds in that country.

U. S. Rubber will also provide technical assistance for the construction and operation of a plant to produce acrylonitrile-butadiene-styrene copolymers and nitrile oil-resistant synthetic rubbers.

Plastics exposition space

All the booths included in the original plan for the National Plastics Exposition, to be held at the International Amphitheatre, Chicago, Ill., from Nov. 17 to 21, 1958, have been sold at a public drawing. Through an arrangement with the Amphitheatre, it has been possible to add a few more booths, which are offered subject to prior sale.

Further details may be obtained from Wm. T. Cruse, executive vice president, The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.

Housewares and freight rates

Molders of plastics housewares are engaged in a complex freight rate battle with the railroads and trucking industry. Since freight rates, prepaid by the molders, account for about 8% of gross sales, the outcome is important to the housewares industry.

At present, all plastics housewares in less than carload lots move at first class rates via rail. But now the railroads, seeking higher rates on all lightweight cargo, have proposed rates up to three times first class on articles weighing less than 4 lb./cu. ft., two times first class on goods from 4 to 7 lb./cu. ft., and first class on articles weighing 12 lb. or more. In turn, the Housewares Traffic Committee of The Society of the Plastics Industry has offered a counter-proposal for one and a half times first class charges on goods under 4 lb., first class on goods 4 to 10 lb., and second class on goods 12 lb. or more. At the same time, the housewares molders themselves made another proposal: that not-nested housewares move first class, nested articles move second class, and articles nested solid move third class. The next hearings with railroad representatives are due in July.

Truck rates have already moved higher than molders would like, and on this front the aim is to get the rates reduced. Molders have formally asked the trucking industry for a flat first class rate on housewares under 12 lb. and second class on items over 12 pounds. At present, the truck cargo rates are double first class for goods under 6 lb./cu. ft., first class for goods 6 to 12 lb., and second class for goods 12 lb. and over.

Those interested in lending their support in this battle should contact the Housewares Traffic Committee of the S.P.I., 250 Park Ave., New York 17, N. Y.

Radio frequency allocation

The Federal Communications Commission has recently released a Memorandum Opinion and Order dismissing four pending petitions of communications interests for re-allocation of the 890 to 940 mc. frequency band and finally reaffirming the allocation of this portion of the radio spectrum as a primary industrial, scientific, and medical (ISM) frequency band.

This action by the Commission (while subject to petitions for reconsiderations) successfully terminates a long fight by the Radio Frequency Heating Committee of The Society of the Plastics Industry, Inc., to preserve this important frequency assignment for plastics preheating and heat-sealing operations.

PVC + steel pipe

The manufacture and sale of unplasticized polyvinyl chloride lined fittings and pipe have jointly been announced by Tube Turns Plastics, Inc., Louisville, Ky., and Swepco Tube Corp., Clifton, N. J. The pipe will be made by Swepco and the fittings by Tube Turns. TTP will market both fittings and pipe, the latter under the brand name Swepcore UPVC lined pipe.

Both the pipe, which will nor-

(*To page* 196)

The plastics business – first quarter, 1958

AN INTERESTING feature of the income reports of various companies listed below is that nearly all of them made a profit in the much-talked about first quarter business decline of 1958, but the drop-off from a near record profit picture for the same period in 1957 made most of them "hurt" like unto a man with a severe toothache. The reports printed here are those that have been made available to the press from companies who have an interest in the plastics industry, but their plastics operations have not been separated from their general operations.

Industry prospects

American Cyanamid will spend $50 to $75 million for expansion in 1958 compared with $84 million in 1957.

Borden. Chemical sales rose 12% and accounted for 5% of total sales. Major building projects were for vinyl chloride, formaldehyde and resin, and butadiene-styrene facilities.

Dow Chemical. Fourth quarter for fiscal year ending May 31 was running about 12% behind last year's similar period. Capital spending in fiscal 1959 will be about $100 million compared to $190 million last year.

Du Pont expects sales in 1958 to be no more than 5% under 1957.

Goodrich, B. F. will spend $35 million for capital expenditures and investment in 1958 compared with $38.8 million in 1957.

Hercules Powder. Plastics accounted for 6% of all sales in 1957. Construction investment was $34½ million in 1956, $22 million in 1957—will be less in 1958. Pres. Forster said index of incoming orders quit going down in April.

National Distillers offered $160 million in debentures, part of which will go for $20 million polyethylene plant of 75 million-lb. capacity scheduled for 1959.

National Vulcanized Fibre budgeted 1958 sales 15% below 1957; first two quarters were 20% below 1957. Reports that inventory cutting by electrical companies which take 35% of National's products is about completed. Capital expenditures this year are $1 million, compared to $1.4 million in 1957.

Resistoflex reports second quarter will be 50% better than first, bringing profit for fiscal year ending June 30 to $458,000 . . . 70% of business is defense orders. Company is adding more people.

Rohm & Haas sales volume has grown from $53 million in 1947 to $174 million in 1957. Company spent $35 million for new facilities in 1957.

Seiberling reports plastics division had its best month in March. Company loss was due to Canadian subsidiary operations.

Union Carbide expects to spend $150 million in plant expansion in 1958 compared to $190.5 million in '57. More than half will go for chemicals, gases, and plastics, sales of which in first quarter were close to level of a year ago and account for 50% of Carbide's business.

Comparison of net incomes

Company	Period	1958 Net Income	1957 Net Income
Admiral	Quarter March 31	(91,977)[a]	565,110
Allied Chemical	" " "	6,776,831	10,007,199
American Cyanamid	" " "	12,376,688	12,922,758
Amphenol	" " "	302,118	425,194
Archer-Daniels-Midland	9 mos. " "	2,584,844	4,433,664
Borden	Quarter March 31	4,213,057	4,640,986
Catalin	" " "	43,307	89,604
Celanese	" " "	2,509,710	2,912,820
Clopay	" " "	(13,559)	92,801
Cons. Paper	" " "	2,588,031	3,080,825
Diamond Alkali	" " "	852,820	2,255,048
Dow Chemical	" Feb. 28	7,948,780	13,617,402
" "	9 mos. " "	36,906,021	39,061,722
Du Pont	Quarter March 31	71,232,649	98,897,480
Eastman Kodak	12 weeks Mar. 23	14,813,674	17,677,378
Ekco Products	Quarter March 31	734,308	890,290
Electric Auto-Lite	" " "	644,787	3,706,272
Ferro	" " "	370,000	490,024
Food Machinery & Chemical	" " "	3,256,260	3,959,720
Goodrich (B. F.)	" " "	6,289,545	10,160,824
Goodyear Tire & Rubber	" " "	10,857,580	17,265,055
Harshaw Chemical	" " "	772,103	1,135,122
Haveg Industries	" " "	71,884	same
Heyden Newport	" " "	406,000	803,000
Hercules Powder	" " "	3,995,000	4,087,904
Interchemical	" " "	615,150	831,924
Koppers	" " "	959,914	1,930,918
L. O. F. Glass Fibers	" " "	292,287	225,005
Metal & Thermit	" " "	174,659	417,449
Minnesota Mining & Mfg.	" " "	7,969,374	9,762,181
Monsanto Chemical	" " "	6,066,000	11,534,000
National Automotive Fibres	" " "	(249,713)	553,791
National Distillers	" " "	5,511,497	n.a.[b]
National Rubber Machinery	" " "	(39,000)	184,000
National Starch Products	" " "	583,048	700,893
National Vulcanized Fibre	" " "	91,700	203,505
Nopco Chemical	" " "	416,848	377,772
Olin Mathieson	" " "	4,473,000	10,010,000
Owens-Corning	" " "	1,892,985	2,366,898
Owens-Illinois	" " "	6,566,417	7,485,251
Pittsburgh Coke & Chemical	" " "	210,000	908,000
Pittsburgh Plate Glass	" " "	5,068,336	13,226,292
Reichhold Chemicals	" " "	419,000	552,000
Resistoflex	" " "	88,429	229,379
Rohm & Haas	" " "	2,849,000	4,102,000
Sandura	" " "	85,000	117,165
Seiberling	" " "	(200,000)	182,542
Sheller Mfg.	" " "	5,895	591,294
Spencer Chemical	" " "	613,726	1,729,868
" "	9 mos. " "	2,191,807	3,257,819
Sun Chemical	Quarter March 31	93,417	219,725
Union Carbide	" " "	22,832,616	35,454,638
U. S. Rubber	" " "	3,890,699	8,179,761

[a] Numbers in parentheses represent loss.
[b] Not available.

The Plastiscope

mally be furnished in steel, and TTP UPVC lined cast iron fittings will be available in sizes from ½ to 3 inches. Cast aluminum and cast steel UPVC lined fittings and Swepcore in aluminum, stainless steel, or special alloy will be furnished on special order.

This new type of piping is said to combine many desirable characteristics of UPVC (high corrosion resistance, non-flammability, non-toxicity, non-aging, no electrolytic action, and smoother interior wall) with the strength of metal and improved temperature resistance. Piping systems fabricated with Swepcore pipe and TTP UPVC fittings are reported to satisfactorily handle temperatures up to 190° F. and pressures as high as 500 p.s.i.

Pearl paste for vinyl

Production of a new solvent-free pearl paste, designed for use in pigmenting vinyl compounds, has been announced by Claremont Pigment Dispersion Corp., 39 Powerhouse Rd., Roslyn Heights, N. Y.

In the past, producers of pearlized vinyl film and sheeting have encountered blistering as well as contamination resulting from disintegrated Banbury packings and residue. These difficulties are claimed to be due to the solvent content of the pastes used. The new pearl paste concentrate, D-4758, which is claimed to be completely free of volatile solvents and non-settling even after a year of storage, eliminates these drawbacks. It contains 70% active pearl essence and sells for $4.45 per pound.

ABS sheet custom-cut

Extruded acrylonitrile-butadiene-styrene sheets, 0.010 to 0.150 in. thick and up to 40 in. wide, are now being offered, custom-cut to individual needs, by Midwest Plastic Products Co., 1803 Chicago Rd., Chicago Heights, Ill.

According to the company, the growing demand for ABS multipolymers is based on the material's properties, such as high impact strength, resistance to heat and cold, toughness, shock resistance, and economy of forming.

Celebrates 15th anniversary

Fifteen years in the field of industrial plastics manufacturing were recently celebrated by Lone Star Plastics Co., Inc., 124 Roberts Cut-Off Rd., Fort Worth, Texas. The company is one of the few organizations in the country performing compression and injection as well as reinforced plastics molding.

The anniversary was celebrated with a three-day sales and instructional school for the sales and engineering staff and an open house with the plant in full production. At the three-day session, Don Maier of Don Maier & Associates, Los Angeles, Calif., engineering sales representatives, was appointed to the newly created post of western sales representative.

With a considerable increase in business already shown for the past year, Melvin Hare, president, states that he's shooting to double last year's volume.

Heavy-duty polyethylene bags

Industrial shipping bags fabricated from 10-mil polyethylene film, conforming with the specifications recently established by the Railroad Joint Classification Committee for domestic rail shipments of plastics materials, are now available commercially from Chippewa Plastics, Inc., Chippewa Falls, Wis.

The railroad specifications call for bags made of virgin extrusion-grade polyethylene heat sealed so that no part of the seal has a tensile strength of less than 1800 p.s.i. at 23° C. or a stretch of less than 350 percent. In addition, net weight of a bag's contents is not to exceed 50 pounds. Approval of these bags is still limited to shipping plastics materials.

These moisture-resistant bags are said to be of particular value for shipping hygroscopic materials and other products adversely affected by moisture or other contaminants. They also permit outdoor storage of packaged materials; and, because the plastic is chemically inert, the bags may be used for a wide range of chemicals and other products, such as polyethylene resins and compounds, ammonium nitrate, carbon black, sodium bisulfate, and seeds.

In large lots, prices range from 20 to 30¢ per bag, depending upon size and printing requirements. The bags are said to be competitive with many standard shipping sacks and less expensive than some specialty containers providing equivalent or less moisture protection and chemical resistance.

Color laboratory

A new $5 million laboratory has been opened to provide service to customers and for evaluation of new or improved products of Du Pont's Electrochemicals and Pigments Departments. The laboratory provides a center for research work on problems of customers, development work on new products and new uses for established products, and training of field technical representatives.

The Electrochemicals wing, on one floor, contains equipment for duplicating customer operations in the peroxygen, chlorine, vinyl, and related product fields.

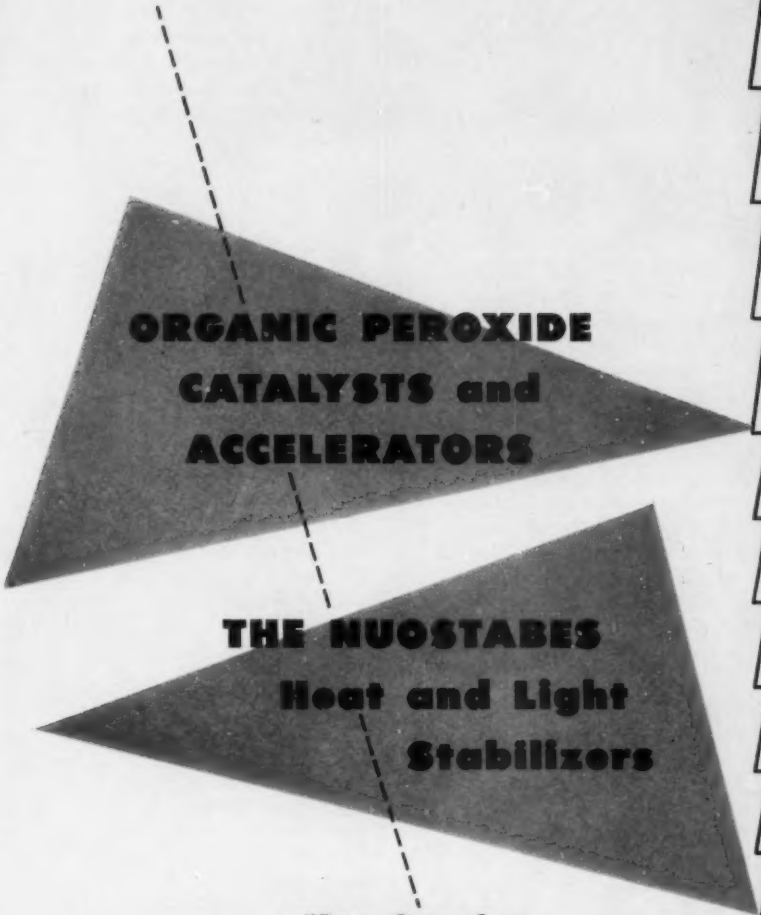
The Pigments laboratory occupies two floors and has facilities for developing tailor-made pigments for the plastics, paint, rubber, paper, ink and other industries.

Another area is devoted to polyvinyl alcohol and polyvinyl acetate, including end-use evaluation in adhesives, paper coating, paints, and other products.

Irradiated polyolefin

Improvements over polyethylene for many electrical and mechanical applications are claimed for Enrad I, a form of irradiated polyolefin developed by Enflo Corp., Fellowship Rd., Maple Shade, N. J.

Stabilized by irradiation prior to molding, the material is said to maintain its characteristics at



Your Complete Source of Supply

The Plastics Industry is now served with organic peroxides and vinyl stabilizers—from a single, qualified source. Nuodex is famous for "uniformity-certified" Nuostabes—backed by extensive research and service facilities. Equal facilities are yours with the Nuodex line of peroxides.

We invite you to call on our Technical Service Laboratory for help in specifying the exact stabilizer or catalyst for your requirements. Write for our catalogs and free samples.

The multi-plant facilities of the Corporation are behind each Nuodex Product. Among those products of interest to you—in addition to the stabilizers and peroxides here listed—are a complete line of Stearates.

BENZOYL PEROXIDE
SILICONE CATALYST NO. 1
50% Benzoyl Peroxide with Silicone Oil

OXIDIZING MATERIAL NOS
B. P. PASTE
50% Benzoyl Peroxide with Tricresyl Phosphate

TECHNICAL LAUROYL PEROXIDE
M. E. K. PEROXIDE
60% Methyl Ethyl Ketone Peroxide in Dimethyl Phthalate

HYDROPEROXIDES
SILICONE CATALYST NO. 2
50% Benzoyl Peroxide with Silicone Fluid

DIBASIC LEAD STEARATE V-1
LEAD STEARATE V-2

BARIUM RICINOLEATE V-10
BARIUM ZINC COMPLEX V-12

BARIUM ZINC COMPLEX V-14
CADMIUM LAURATE V-20

CADMIUM V-21
CADMIUM COMPLEX V-122

BACAD LAURATE V-130
BACAD (CO-PRECIPITATED) V-131

BARIUM CADMIUM COMPLEX V-132
BARIUM CADMIUM COMPLEX V-133

CHELATOR V-40
CHELATOR V-141

CHELATOR V-142
ZINC V-50

ZINC COMPLEX V-152
CALCIUM STEARATE V-60

STRONTIUM STEARATE V-70
STRONTIUM ZINC LAURATE V-171

ORGANO-TIN V-82
ORGANO-TIN V-183

EPOXY V-205
VINYL FUNGICIDE 100-VT

NUODEX ADDITIVES AND S/P CHEMICALS

NUODEX PRODUCTS COMPANY • ELIZABETH, NEW JERSEY
A DIVISION OF HEYDEN NEWPORT CHEMICAL CORPORATION

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temperatures where polyethylenes flow like liquids. Compared with regular and high-density polyethylene, Enrad I is reported to provide better rigidity, higher tensile strength, form stability to 300° C., and good electrical properties, even after extended exposures to temperatures as high as 250° C.

Controls butyrate odor

Odors characteristic of butyrate plastics are said to be controlled easily with a chemical called Alamask BMI developed by Rhodia, Inc., 60 E. 56th St., New York 22, N. Y.

Alamask BMI, an addition to the series of odor-control chemicals produced by the company for packaged products, is claimed to cover the plastic odors without imparting an odor of its own to the package or its contents. It is oil-soluble, long-lasting, and is reported to withstand normal conditions of molding and extrusion without losing its masking characteristics. The company states that normally no more than 0.05% by weight of Alamask BMI is required for nullification of the butyrate odors.

Officers for CMRA

At the annual meeting of the Chemical Market Research Association held recently, the following officers for 1958-59 were announced:

President—Kenneth R. Parker, manager of Market Research, B. F. Goodrich Chemical Co.; president-elect—J. E. Sayre, Barrett Div., Allied Chemical Corp.; secretary—W. C. Gwinner, Esso Standard Oil Co.; and treasurer—E. W. Eipper, Stauffer Chemical.

Durez Div. autonomous

The Durez Plastics Div. of Hooker Chemical Corp. (formerly Hooker Electrochemical Co.) has been decentralized and will now operate as an autonomous division of the corporation. The three facilities involved are the division's headquarters plant at N. Tonawanda, N. Y., manufacturing synthetic resins and molding compounds; the Kenton, Ohio, plant which manufactures phenolic molding compounds; and the Spokane, Wash., plant making wood flour.

In the decentralization, Dr. Jay C. Searer, formerly division works manager, becomes division general manager, reporting to the president. Alfred W. Hanmer, Jr. continues as division general sales manager. Charles Y. Cain, formerly administrative assistant to the division general sales manager, now division assistant general sales manager. John F. Snyder, Jr., who was works manager at Kenton, becomes production manager for the division and will transfer to N. Tonawanda. William J. Parmley, formerly division supervisor of laboratory production and process development, now moves to Kenton as superintendent. Lother A. Sontag will continue as division technical manager.

Who's who in engineering

The eighth edition of "Who's Who in Engineering" is scheduled for publication at the end of this year. Information that has not been brought up to date by individuals previously listed will not be published in the new edition. Therefore, engineers are urged to return the clipping which was mailed to them. Those who did not receive clippings should contact the editors of "Who's Who in Engineering," 265 W. 14th St., New York 11, N. Y.

Full-color printing on polystyrene

A new lithographing technique that permits full-color printing on polystyrene sheets has been developed by Thunderbird Plastics, Inc., 650 Ottawa Ave. N., Minneapolis 22, Minn. Heretofore, polystyrene was limited to two-color reproduction.

According to the developer, the process is substantially less expensive than silk screening and cannot rub or wear off. It gives sharp detail and clear color definition without raggedness. A special formula ink is used which "bites" into the plastic. Subsequent vacuum forming imparts a high gloss to the colors and appreciably heightens their visual impact.

Window for Sno-Cat

The first Trans-Antarctic crossing by land—or snow—was commemorated recently by a special postal mailing from Scott Base at the South Pole. Tucker Sno-Cat Corp., Medford, Ore., manufacturer of the trucks used in the expedition, sent word by this mailing that the history-making Sno-Cats depended upon Cast Optics Corp.'s Evr-Kleer acrylic sheets for outstanding performance during this grueling expedition.

Melamine at China Show

The Policy Steering Committee of The Melamine Council has endorsed the China and Glass Show, to be held in January in Atlantic City, N. J., as enabling the industry to display its products under conditions compatible with the stature of the melamine dinnerware industry. Many molders have requested space in the Show.

The committee is composed of molders elected by the 28 melamine dinnerware manufacturers participating in The Melamine Council to supervise the Council's work.

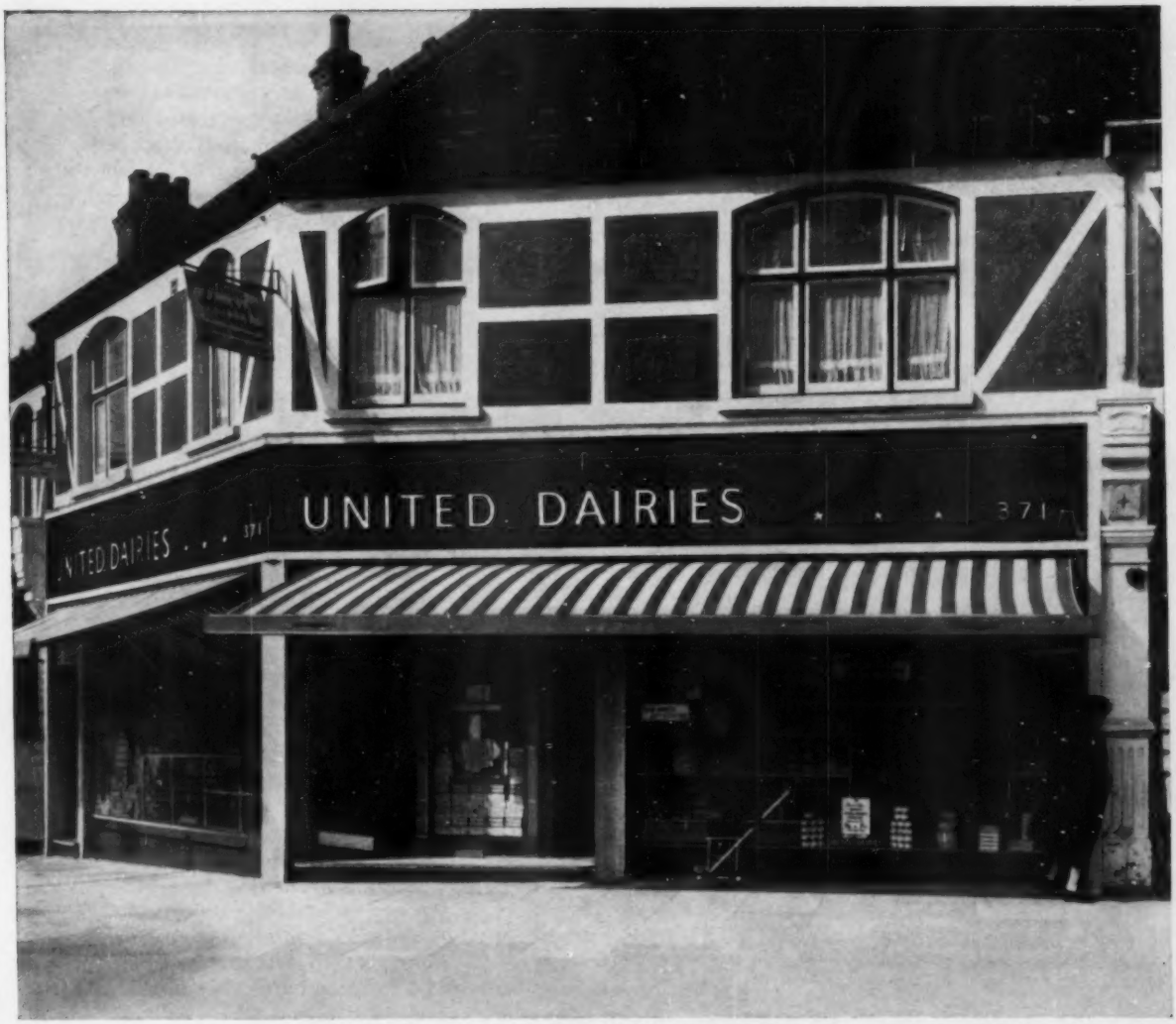
Plastics pipe distributor

Plastitrol, 1974 Charle St., Costa Mesa, Calif., has been recently formed to distribute plastics piping. The firm will stock brand name piping items of PVC, Kralastic, low- and high-density polyethylene, as well as polypropylene, polystryene, Penton, Teflon, Kel-F, etc.

Newton Crum is manager of the company.

Acrylic sheets

New facilities for the production of acrylic sheets with close tolerances have been announced by The Polycast Corp., 69 Southfield Ave., Stamford, Conn. Clear and color sheets, 36 by 36 in. in stand-



Red 'Perspex' was used for the facia of this English United Dairies Shop and also for panelling around the door. Architect F. T. Dear, F.R.I.B.A., Contractors C. Oliver & Son (Builders) Ltd., Subcontractors: Fredrick Sage & Co. Ltd.

'Perspex' makes a good name stand out

'PERSPEX' is the ideal plastics material for shop facias. It is tough and good-looking and will give excellent service. It has, indeed, stood the test of time, both indoors and out. 'Perspex' is available in clear and opal sheet or in a wide range of transparent, translucent and opaque colours. It combines lightness with strength and transparency, which gives it special value in many situations. 'Perspex' is so easy to shape and form that it encourages novelty in design.

'PERSPEX'

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

IMPERIAL CHEMICAL INDUSTRIES LIMITED,
PLASTICS DIVISION: EXPORT DEPT., BLACK FAN ROAD, WELWYN GARDEN CITY, HERTS.

U.S.A. enquiries to: J. B. Henriques Inc.,
521 Fifth Avenue, New York 17, N.Y.

Canadian enquiries to: Canadian Industries Ltd.,
Plastics Dept., Box 10, Montreal, P.Q.

ICI

P644/0/A

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ard thicknesses from 0.040 to ¼ in. are available, as well as grades meeting MIL-P-5425B and MIL-P-6886B specifications.

The company has also expanded its line of patterned acrylic sheets which include hammered, pebble, ribbed, ripple, and transparent diamond patterns.

Synthetic resin for floor waxes

An acrylic copolymer latex, 9425 Acripol, which is said to make possible floor waxes with greater scuff resistance, gloss, and spreadability, is being marketed by Reichhold Chemicals, Inc., White Plains, N. Y. When used together with RCI's modified alkyd, Waterez, the two materials would constitute 85% by weight of the typical household floor polish formulation.

Conventional self-polishing waxes contain 20% or more wax and about 80% alkali-dispersion resin. The new formulation recommended by RCI consists of 15% or less emulsified wax, 15% Waterez, and at least 70% 9425 Acripol. Some 60 million lb. of floor polish are used in the U. S. annually.

The main advantage of the acrylate is said to be its ability to rest on the surface rather than to be dissipated into the pores of the floor covering. It will compete with polystyrene emulsion in the floor polish field. RCI believes the acrylate will also find applications in shoe dressings and surface coatings, and in textile, paper, and leather products.

Metallized polyethylene

A new process for vacuum metallizing polyethylene, designed to fit into conventional metal decorating plants, has been announced by Syn-Cote Chemical Corp., 44-27 Purvis St., Long Island City 1, N. Y.

Vacuum metallized polyethylene is mirror-bright, rich and lustrous in appearance. Metallized toys, bottles, mats, and jewelry are among the applications which are expected to compete in markets previously reserved for metals and other more expensive materials.

Special top and base coat lacquers were developed to achieve the flexibility and adhesion required for polyethylene. They are claimed to be storage stable, easy to use, and formulated for optimum film properties on polyethylene. Coated and metallized polyethylene articles can be dyed to any desired shade by conventional methods.

Several vacuum metallizers are currently being licensed by Syn-Cote.

Blown vinyl bottle

A 4½-fluid oz. blown vinyl bottle for its oil retention enema is being marketed by C. B. Fleet Co., Inc., Lynchburg, Va. The unit, made by Plax Corp., Hartford, Conn., is disposable and is designed for maximum squeezability to empty the contents completely.

Vinyl was chosen for this application because the enema has a mineral oil content which could not be satisfactorily packaged in polyethylene, and the use of an internal bottle lining to hold the oil would not have met specific customer requirements.

Soft vinyl fabric

A new type of upholstery material for home furniture, claimed to combine the lasting qualities of vinyl with the versatility of soft woven fabric, has been added to the Breathable Naugahyde line manufactured by United States Rubber Co. Designated Trend, its base is a soft woven fabric which is reinforced with a special protective vinyl coating that provides color fastness and resistance to soiling. The soft, modern vinyl pattern is then permanently fused to the fabric. Silvery metallic flitters accent the design.

The new construction is said to produce upholstery that is breathable, soft in feel, supple, easy to tailor, and long wearing.

Trend is being introduced in 10 colors, 54 in. wide, and will be sold in 30-yd. rolls through distributors and direct to volume furniture manufacturers. It is made in the company's Stoughton, Wis., plant.

Reinforced plastics

For smooth surfaces. Famco-Fiber surfacing mats, made from continuous glass fibers, are being offered by Famco, Inc., 6200 Strawberry Lane, Louisville, Ky. When used in conjunction with conventional reinforcing mats, the new mat is said to provide a smooth surface for finished products where appearance or weather resistance is important.

Famco-Fiber surfacing mats are available with either polyester or thermosetting acrylic binder. They are said to be uniform, wrinkle-free, soft, and drapable.

National distribution. Naugatuck Chemical Div., United States Rubber Co., producer of polyester resins used for reinforced plastic molding, has concluded a marketing agreement with Russell Reinforced Plastics Corp., Lindenhurst, N. Y., and Boca Raton, Fla., manufacturer of Tropiglas reinforced plastic panels, to distribute these panels nationally.

The chemical division is organizing a nationwide distribution system for the panels, which are made in 22 colors and in three basic types of construction.

Rolled lightweight sheeting. A 4-oz. flat fibrous glass-reinforced plastic material in roll form has been developed by Filon Plastics Corp., El Segundo, Calif. The more pliable roll was developed for easier application to table tops, planters, shelves, sandwich construction, and other residential uses. It is also reported to eliminate cutting waste encountered with standard-sized rigid panels.

Consultant services. Proman Corp., Grand Haven, Mich., has been recently formed and will engage in engineering, design, research, and development, mainly

in the reinforced plastics field. The company will develop products and production techniques as well. Pilot line facilities are being established, and are expected soon to cover an area of 12,000 sq. feet.

Book on reinforced plastics. A book on mechanical attachment and machining of fibrous glass-reinforced plastics is being prepared by T. B. Blevins, Rhodale Associates, 1310 Annandale Rd., Falls Church, Va. He is anxious to receive useful data on these subjects. Any contributor will receive recognition and a free copy of the book if his material is used.

Expansion

American Cyanamid Co. will start construction of a multi-million dollar maleic anhydride manufacturing plant adjoining its present production facilities at Bridgeville, Pa. The new unit, scheduled for operation late in 1959, will be incorporated into the operations of the Plastics and Resins Div. and will have an initial production capacity of 14 million lb. annually.

Atlas Powder Co. announces the opening of its $3 million Technical Center in suburban Wilmington, Del. The building, providing 70,000 sq. ft. of floor space, will house the Chemical Research Dept.; the Chemical Div.'s Product Development Dept.; and a working force of over 100 laboratory professionals, more than 50 laboratory technicians, and other personnel.

U. S. Polymeric Chemicals, Inc. has completed a processing plant in Utrecht, Holland, through its wholly-owned subsidiary, **Polymeric N.V.** Two other Polymeric plants are located in Stamford, Conn., and Santa Ana, Calif.

Equipment in the new facility is said to mark a radical departure from practice in the United States. A new German treater, based on new concepts of prepreg treatment and featuring high-velocity drying, is the heart of the new unit. It is expected to provide the production equivalent of several conventional units.

According to the company, the

It's the **BALANCED *Synclinal* DESIGN**

that makes

MARVEL

Synclinal

FILTERS

American

Industry's

A-1 CHOICE

SUMP TYPE (cutaway)

LINE TYPE (cutaway)

In the plants of America's industrial giants, as well as in smaller plants, Marvel Synclinal Filters are being installed on all types of hydraulic and other low pressure liquid circulating equipment. Marvels are chosen because of their excellent performance in protecting machines and increasing production by reducing down-time. They are proving again and again, their superiority in the one real test—ON THE JOB! The BALANCED Synclinal Design of Marvel Filters provides that all-important balance between maximum ACTIVE filtering area and sufficient storage space for filtered out particles —therefore, longer periods of productive operation are attained at the absolute minimum of maintenance. They meet J.I.C. Standards.

Not only plant operators, but also OVER 800 ORIGINAL EQUIPMENT MANUFACTURERS have recognized the superiority of Marvel Synclinal Filters and now install them as standard equipment.

Specify MARVEL SYNCLINAL FILTERS on New Equipment— Standardize with Marvel's on Existing Equipment

EASY MAINTENANCE

Both sump and line types may be easily disassembled, cleaned and reassembled by any workman, on the spot, in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G.P.M. Greater capacities may be attained by multiple installation (as described in catalog). Choice of monel mesh sizes range from coarse 30 to fine 200.

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Catalogs contain dimensional charts and complete engineering data making it easy to order a filter for your specific requirements and get Immediate Delivery.

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- ☐ Catalog #108—For Hydraulic Oils, Coolants Lubricants.
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-Resistant Hydraulic Fluids (Synthetic).
- ☐ Catalog #301—For Water

MP-7

Name .....

Company .....

Address .....

City .....

State .....

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new plant will be capable of duplicating the complete U. S. Polymeric line of polyester, silicone, epoxy, melamine, and phenolic pre-pregs.

Petro-Tex Chemical Corp. has started construction of a high-purity isobutylene plant at Houston, Texas. The company asserts that the product will be above 99% purity and will be available in pressure-type tank cars by the end of the year. The capacity of the plant is said to be large enough to supply a substantial part of the market for isobutylene, which is used in polymers and alkylated compounds.

Petro-Tex is jointly owned by **Tennessee Gas Transmission Co.** and **Food Machinery & Chemical Corp.**

Morningstar-Paisley, Inc., 630 W. 51st St., New York 19, N. Y., has expanded its plastisol and sales and laboratory facilities and installed additional pilot plant equipment at its New York City location. This move will be followed by the installation of new processing equipment at Clifton, N. J., adjoining the firm's Haberland plant.

The company entered the plastisol and latex field in October 1957 when it purchased Federal Latex Corp. and Federal Chemical Corp., Brooklyn, N. Y. **Samuel Tisser,** who headed this operation for Federal, continues as manager of the department for Morningstar.

Federal Sign & Signal Corp., Chicago, Ill., designer and manufacturer of electrical outdoor advertising signs, has acquired **Lackner Co.,** Cincinnati, Ohio, 40-year-old producer of quantity illuminated plastics displays.

Production equipment and some key personnel of the Ohio firm are being combined as a full department in Federal's headquarters in Chicago. Federal's quantity plastics display operation will be the first department to move into the firm's newly acquired plant now being remodeled and expanded at 136th and Western Ave., Blue Island, Ill. Later this year, Federal's entire plant and general offices will join the Plastics Div. in the new location.

National Vulcanized Fibre Co. has moved its Midwest headquarters from 2808 W. Lake St., Chicago, Ill., to its new plant at 2415 Gardner Rd., Broadview, Ill., which provides over 30% additional capacity.

The 22,000-sq. ft. structure incorporates fabricating facilities; increased warehouse space for laminated plastics, nylon, and vulcanized fibre; an enlarged tool making section; and a sales office which serves 12 Midwestern states.

Swedlow Plastics Co., Los Angeles, Calif., has acquired from **Pacific Optical Corp.** the equipment and know-how employed in the grinding and optical polishing of transparent plastic materials for glazing applications. Equipment and personnel will ultimately be transferred to the Swedlow plant, where polishing facilities are being expanded.

Industrial Plastics Fittings Co. and **The R & K Tool & Die Co.,** both located at 3891 W. 150th St., Cleveland, Ohio, have pooled their facilities to form a new organization offering custom molding and a full line of plastic pipe fittings.

The new company will be called **The R & K Plastic Industries Co.,** with **John A. Rybak** as president.

Fabrico Mfg. Corp. has tripled its production facilities by leasing all three floors of the building at 1714 W. Division St., Chicago, Ill., where the firm had until recently occupied only one floor.

Fabrico manufactures plastics sportswear, industrial items, swimming pool liners, inflatable air mattresses, travel bags, etc.

Plastics Mfg. Co. is now occupying its new facilities on a 7½-acre site in the Santa Fe industrial district of Dallas, Texas. The structure was designed specifically for the manufacture of melamine dinnerware.

The sales force has grown from one salesman in 1946 to about 50. The New York showroom is located at 212 Fifth Ave.

Carmer Industries, Inc., Kenilworth, N. J., extruder of Kel-F, nylon, and Teflon, has doubled its plant facilities, adding new equipment and expanding its laboratory facilities.

Meetings

Plastics groups

September 12: Society of Plastics Engineers, Inc., Regional Technical Conference, St. Clair Inn., St. Clair, Mich. Subject: "Plastics in Automotive Application."

October 1: Society of Plastics Engineers, Inc., Regional Conference, Hotel Statler, Hartford, Conn. Subject: "Plastics in Packaging."

October 9-10: The Society of the Plastics Industry, Inc., 14th New England Section Conference, Wentworth-by-the-Sea, Portsmouth, N. H.

October 21: Society of Plastics Engineers, Inc., Regional Technical Conference, Curtis Hotel, Minneapolis, Minn. Subject: "Epoxies."

Other meetings

September 9-12: National Chemical Exposition, in conjunction with the 134th National Meeting of the American Chemical Society, International Amphitheatre, Chicago, Ill.

October 20-22: Technical Association of the Pulp and Paper Industry, 13th TAPPI Plastics-Paper Conference, Sheraton-Kimball Hotel, Springfield, Mass.

October 20-24: American Vacuum Society, Inc., 5th National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif.

Companies . . . People

American Cyanamid Co.: Nolan B. Sommer, previously marketing mgr. of plastics in the **Plastics and Resins Div.,** now assistant to **K. H. Klipstein,** exec. VP. Dr. Sommer joined the company in 1944 as a research chemist in its Stamford, Conn., laboratories and subsequently served as mgr. of Cyanamid's New Product Development Dept. **R. G. Head,** formerly marketing mgr. of

N. B. Sommer

R. G. Head

resins, succeeds Mr. Sommer as marketing mgr., responsible for all division products.

Organic Chemicals Div.: R. E. Leach, with the company 22 years, appointed asst. mgr. for the Willow Island, W. Va., and Marietta, Ohio, plants; **R. J. Clay** named prod. mgr. and **J. Kondrick** services mgr. for these plants. Mr. Clay joined the firm nine years ago and Mr. Kondrick, a veteran of 28 years with Cyanamid, started at the Bound Brook, N. J., plant.

Formica Corp.: Jeffrey Supply Co., 2310 Preston Ave., Rockford, Ill., named distributor for Formica laminated plastics as a branch of **Veneer Distributors,** Chicago, Ill. **Richard Boblo,** formerly mgr. of Veneer's Gary, Ind., warehouse, named mgr. **Plasticrafts, Inc.,** 1629-4th St., N.W., Albuquerque, N. M., has been organized as a division of Plasticrafts, Inc., Denver, Colo., and will distribute Formica products in the Albuquerque area. **George Lackmann** appointed mgr. of the Albuquerque operation.

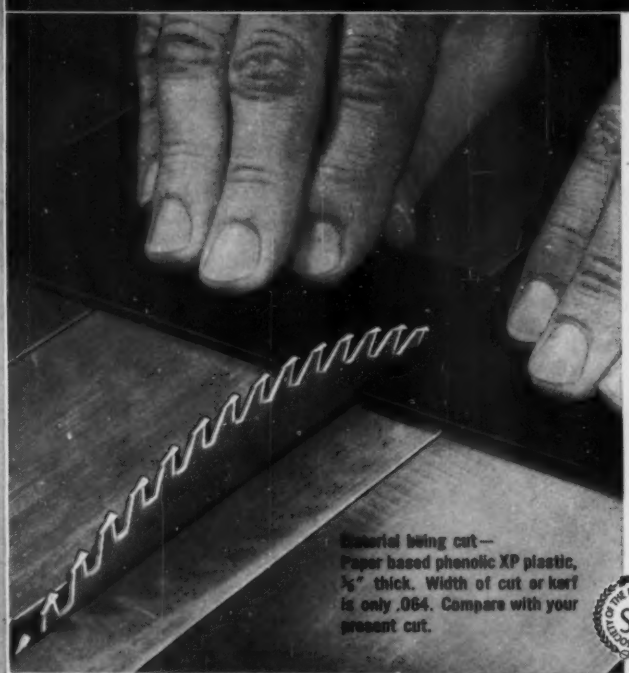
Allied Chemical Corp., Barrett Div.: Dr. Maurice H. Bigelow, formerly tech. dir., appointed VP. He will continue as head of the division's Research and Development Dept. **Stanley C. Gerrard,** with the company 21 years, named asst. dir. of Industrial Relations. **Robert K. White,** formerly responsible for advertising activities for Plaskon products, named to the newly-created post of marketing mgr. for Plaskon plastics and resins. He will also head up sales and marketing personnel development.

Spencer Chemical Co., Research and Development Div.: Dr. Nat C. Robertson, formerly gen. mgr. of research and development, appointed VP—research and development. **Dr. O. V. Luke,** named dir. of central research, will supervise the activities of the firm's research center at Kansas City, Mo., including work in the fields of plastics as well as industrial and agricultural chemicals.

The C. P. Hall Co. of Illinois: S. A. Davis, formerly exec. VP, elected pres.; **C. K. McMillen,** VP and treas.; **C. R. Hall,** VP in charge of research; and **W. T. Hall,** secy. The company manufactures esters, plasticizers, emulsifiers, and other organic products, and is a distributor of heavy chemicals in the metropolitan area of Chicago.

Reichhold Chemicals, Inc.: Ralph T. Urich appointed VP and gen. mgr. He joined the firm in 1939 and was associated with sales and research in inorganic color pigments. During the war years, Mr. Urich's services were donated to the War Production Board at its request; in 1951, he was recalled to Washington to help reorganize the National Production Authority. Since then, he has worked

no edge chipping or cracking...



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Companies... People

with sales and research on all of the basic chemicals and resins produced by RCI. **Herbert L. Wampner,** with the company 15 years and previously tech. dir. of the Pacific Coast Div., named dir. of research of RCI. He will headquarter at White Plains, N. Y. **Dr. Arthur L. Wooten** named gen. mgr. of the New England Div. He will have his headquarters at the Ballardvale, Mass., plant, where he has been the division's tech. dir. since last year.

Gemloid Corp., Long Island City, N. Y.: **Leonard E. Elterman,** formerly pres. of Popular Plastics Products Corp. and several related corporations, elected pres. He has purchased the entire stock and interest of **Joseph Frank,** founder of Gemloid. **Carl Haller,** pres. of **Haller Plastics Corp.,** elected VP, secy., and treas.

The company does injection and compression molding, extruding, and laminating.

The Hydraulic Press Mfg. Co., Div. of Koehring Co., Mount Gilead, Ohio: **E. L. Oehling** promoted from gen. sales mgr. to VP—sales; **T. G. Bishop,** previously mgr. of the Plastics Machinery Div., appointed product market mgr.; **W. G. Kriner,** formerly mgr. of dealer sales, replaces Mr. Bishop as head of the plastics division.

National Starch Products, Inc.: Frank Greenwall (left in photo below), pres. since 1938, elected chrmn. of the board and chief executive officer. **Donald D. Pascal** (center) formerly exec. VP, succeeds Mr. Greenwall as pres. and chief admin.

officer. **James Dillon** (right), elected sr. VP. He will be responsible for exploring and developing new fields of company activity and growth, in addition to assuming the chairmanship of National's Research Committee.

Canadian Resins & Chemicals, Ltd.: Edward A. Clout, with the firm six years, appointed supv. of the Calendered Materials Div. **Arthur G. Pinard,** with the company 13 years, now mgr. of the Industrial Products Dept.

Monsanto Chemical Co.—Plastics Div.: Dr. Cecil E. Johnson, previously dir. of research planning, named asst. research dir. in charge of planning, personnel, and control functions. **Robert R. Lawrence** appointed mgr. of planning. **Dr. Ralph I. Dunlap,** formerly dir. of research administration, named to newly-created post of prod. tech. service mgr. for eastern operations.

Organic Chemicals Div.: Arthur P. Kroeger, formerly associate dir. of marketing, now dir. of marketing at St. Louis, Mo. He succeeds **John L. Hammer, Jr.,** who resigned to become asst. to the pres. of **Mississippi Lime Co.,** Alton, Ill.

Goodyear Tire & Rubber Co.—Research Div.: R. C. Waller promoted to mgr.—plastics research; **V. J. Anhorn** to mgr.—organic chemicals processing; **S. D. Gehman** to mgr.—physics research; and **F. J. Young,** mgr.—process engineering.

Films and Flooring Div.: John E. Kiel and **Stanley J. Thorsten** appointed packaging films reps. for Chicago, Ill., and Atlanta, Ga., respectively.

Pittsburgh Coke & Chemical Co.: Dr. Salvatore Piccione now with the Analytical and Physical Research Section of the Research and Development Dept. **Donald L. McCuen,** previously tech. rep. for Polymer Chemicals Div. of W. R. Grace & Co., named Philadelphia sales rep. for the Industrial Chemicals Div. He succeeds **Walter H. Daub,** who has

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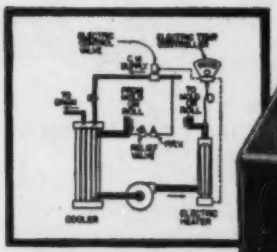

▲ Schematic diagram of control circuit in the Sarcotrol Model MC-1, Single Unit. Model MC-2, Dual Unit, is equipped with two of these circuits. Model MC-3 has three complete circuits.

Sarcotrol Model MC-2 Heating and Cooling Unit for injection molds, cylinders, rolls and drums. Fully enclosed. Easily seen, completely accessible control knobs. ▶

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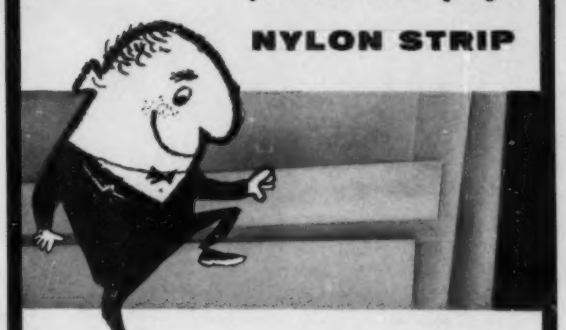

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Companies . . . People

returned to headquarters in Pittsburgh, Pa., on an assignment to the Product Development Section of the Industrial Chemicals Div.

The General Tire & Rubber Co.: Earl F. Miller appointed mgr. of the Ashtabula, Ohio, chemical plant. **P. J. Wallace,** the former plant mgr., now prod. mgr. of the company's new synthetic rubber plant at Odessa, Texas.

Acheson Dispersed Pigments Co.: Edward W. DeLaet appointed mgr. of the Xenia, Ohio, plant to succeed the late **William R. Edwards. John A. Battler** named supv. of the process research group in the Research and Development Dept. at Philadelphia, Pa. **Nicholas H. Alex,** previously with Du Pont, has joined the market research and development group in the Sales Dept.

Foster Grant Co., Inc.: Dr. Raymond H. Hartigan, formerly dir. of research of the Mellon Institute, appointed VP and dir. of research and development. **Edward Kodys** named works mgr. of the Molded Articles Div., assisted by **Jack Berger, Bernard McDowell** appointed plant supt.

R. H. Hartigan

The company manufactures chemicals, polymer derivatives, and molded polymer products.

St. Regis Paper Co., Panelyte Div.: New sales office opened at 235 Montgomery St., San Francisco, Calif., headed by **Robert L. Bunting.**

Wendell Trest appointed sales rep. for Memphis; **Robert A. Rosenberry** named distributor salesman for Cleveland; **Donald P. Robinson** joined the Chicago sales staff.

The following distributors appointed: **Buell & Co.,** 2439 Swiss Ave., Dallas, Texas; **Neidhoefer & Co.,** First Ave. North and 6th St., Minneapolis, Minn.; **Penn-Valley Plywood, Inc.,** 2400 Richmond St., Philadelphia, Pa.; **Seifer Hardware Co.,** 469 S. 17th St., Newark, N. J.; and **California Plywood Co.,** 1271-45th St., Emeryville, Calif.

Chemetron Corp., is the new name of the company formerly known as National Cylinder Gas Co. Divisions of Chemetron involved in plastics are **Tube Turns, Girdler Process Equipment,** and **Chemical Products Divs.**

Chemo Products, Inc., W. Warwick, R. I., is the new corporate name of Chemo Textiles, Inc. The name

(*To page* 210)

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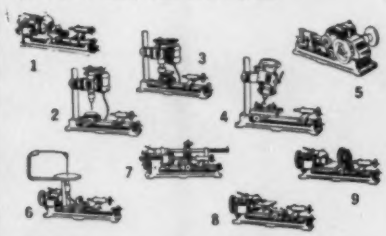

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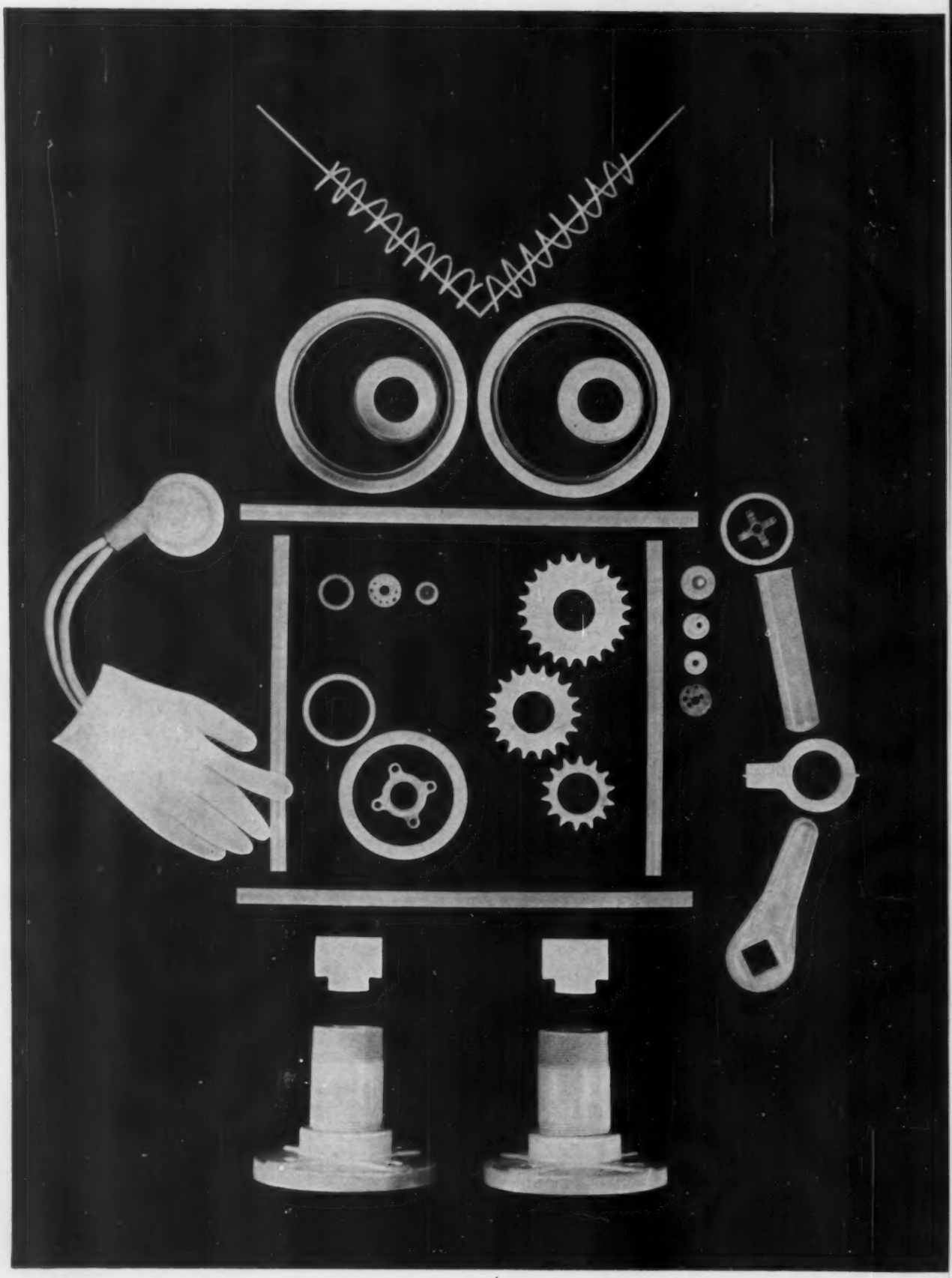

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Pioneer! The gentleman at left represents a whole new family of 3M plastic polymers that are pushing back thermal barriers for countless electrical and mechanical products.

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KEL-F Plastic is tough stuff. It offers exceptional dimensional stability, high impact, tensile and compressive strength, and it's highly abrasion-resistant. KEL-F Plastic is workable stuff. It can be compression-, transfer- or injection-molded on standard equipment. And because of its unique properties, it is easier to extrude into tubing or wire insulation. It can be punched, drilled or machined.

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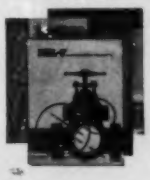

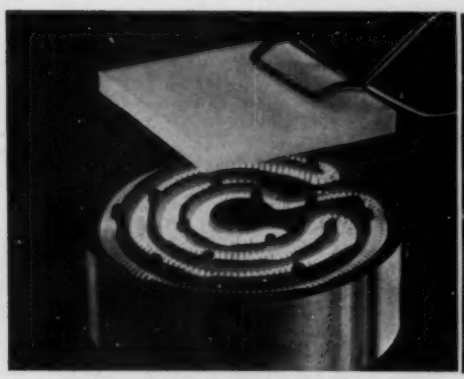

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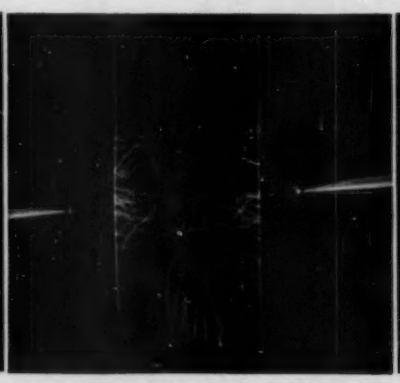

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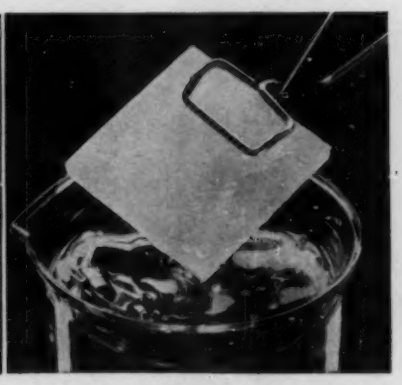

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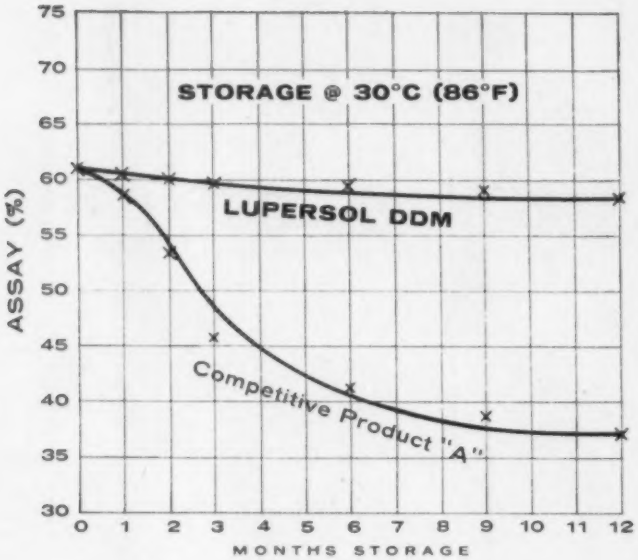

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Storage tests of LUPERSOL DDM show no appreciable loss of assay after 1½ years of storage at ambient temperatures (20-80°F.). LUPERSOL DDM is readily soluble in most synthetic resin monomers and is a convenient non-viscous liquid catalyst for the polymerization of polyester and vinyl type resins. It is useful in developing "room temperature" cures with polyester resins, which require an accelerator such as cobalt naphthenate. Depending on the polyester resin used, the cobalt may already be present or may have to be added separately. The recommendations of the resin supplier should be followed in making up formulations for "room temperature" cures. When catalyzed with LUPERSOL DDM, certain mixed, unsaturated polyesters polymerize to give hard, infusible materials strongly resistant to the usual solvents and highly useful in laminating, coating and impregnating work.

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Companies... People

change is the result of an expansion of the firm's product line. Chemo is now molding Teflon and Kel-F, Teflon skived type, and Teflon rod, tube, and sheet. The company will continue to coat glass yarns with vinyl, Teflon, silicone, latex, and nylon for primary use in electrical insulation and insect screening.

Electromold Corp., Trenton, N. J.: **L. William Ullrich**, chemist, named to head the firm's new Product Research and Development Dept. **E. Russell Ashley**, VP and gen. mgr. asserts that the function of the new department will broaden the versatility of the company's services, including development of ways and means of reducing mold manufacturing time through improved electroforming methods and newly discovered electrochemical techniques.

Emery Industries, Inc. has relocated its New York sales office to 1 Exchange Pl., Jersey City 2, N. J.

Eaton Chemical & Dyestuff Co., Detroit, Mich., appointed representative for **Semet-Solvay Petrochemical Div., Allied Chemical Corp.**, and will market A-C Polyethylene 6 and 629 in Michigan.

M. Holland Co., reprocessor and supplier of plastics raw materials, has moved to larger quarters at 956 W. Huron St., Chicago 22, Ill., comprising an area of about 50,000 sq. feet.

Instron Engineering Corp., manufacturer of precision materials testing equipment, has moved from Quincy, Mass., to its new plant at 2500 Washington St., Canton, Mass. The new structure is twice as large and includes 18,000 sq. ft. of manufacturing space and 7000 sq. ft. for administrative and engineering staff offices.

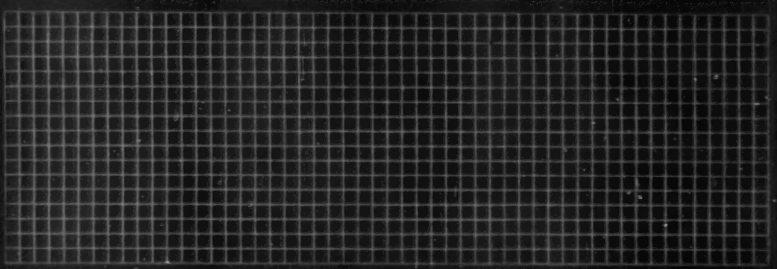
E. J. Tolle, formerly with Ozalid, a Div. of General Aniline Film Corp., appointed sales mgr. and will establish regional sales offices throughout the United States. **Robert O. Smith** named prod. mgr. in charge of plant operations.

Arthur A. Carlson & Associates, 7127 Third Ave., S., St. Petersburg, Fla., named Florida sales rep. by **Synthane Corp.**, Oaks, Pa.

A. Jackson Cheney, formerly supervisor of application design for the Plastics Sales Div. of **Du Pont's Polychemicals Dept.**, appointed market development specialist to work with independent design consultants. Mr. Cheney has been active in the plastics industry for 16 years, dividing his time between research, sales, and plant design and development. In

WHAT THEY'RE BOTH SAYING ABOUT NEW LUSTREX* PERMA TONE STYRENE

Lighting Fixture Molders: "Easy flow, fast cycles..." "No molding job too difficult." "Constant color during molding..."



Lighting Fixture Manufacturers: "2 to 3 times more resistant to yellowing..." "Exceeds IES–NEMA–SPI specs for light stabilized styrene." "Excellent crystal clarity... unlimited color possibilities."

The development of Lustrex perma tone further accelerates the trend of the lighting market toward styrene. To all the inherent advantages of styrene—the large areas of illumination, the light weight, good diffusion, unusual design effects—is now added excellent light stability, a resistance to yellowing up to three times better than regular styrenes. And the low color level of perma tone opens up wide new dimensions in color, including truly translucent whites and other difficult colors.

Lustrex perma tone styrene is available for injection molding or extrusion in the entire Lustrex *Balanced Line:* Hi-Flow 55, 66, 77 and Hi-Heat 99. Write for complete technical data to Monsanto Chemical Company, Plastics Division, Room 222, Springfield 2, Massachusetts.

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Brown also manufactures: Single Station—Plug Assist Forming Machines, Polishing Rolls and Sheet Take Off Equipment, Temperature Control Units, and Continuous Forming Machines.

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Companies . . . People

his new post, he will act as liaison between Du Pont and industrial designers using Du Pont plastics. He was associated with the preparation of the recently published handbook, "Designing with Du Pont Plastics."

Dr. Herman Sokol named exec. VP of **Heyden Newport Chemical Corp.** He has been VP in charge of all Heyden research and development since 1954 and, since the Newport combination, has been responsible for coordination and integration of research facilities and activities for all divisions of Heyden Newport.

Capt. Charles E. Trescott, U. S. N. (ret.), named VP and gen mgr. of **Zenith Plastics Co.,** a subsidiary of **Minnesota Mining & Mfg. Co.,** Gardena, Calif. He will be responsible for all operations of the company, with **Milton Brucker,** Zenith founder and pres., operating in a consultant capacity. Capt. Trescott joined the firm in November 1957 as a mfg. mgr.

Mario J. Petretti, formerly VP—engineering of Camfield Fiberglass Plastics Corp., has joined **Product Techniques, Inc.,** Hudson, Ohio, as VP in charge of sales for the midwestern region. The company is a national sales and service organization handling raw materials for the reinforced plastics industry.

Thomas C. Werbe, Jr. named gen. mgr. of **Robbins Plastic Machinery Corp.,** subsidiary of **Lynch Corp.,** Elkhart, Ind. The parent company acquired Robbins in July 1957 and Mr. Werbe has been Robbins' sales dir. since early 1958, in addition to his other sales and administrative duties at Lynch's general offices in Anderson, Ind.

William Johnson, pres. of **Modern Plastic Machinery Corp.,** is making a gradual recovery from a broken hip, thigh bone, and other injuries sustained in an automobile accident. He is expected to return to work sometime in August or September. He is presently recuperating in the Hasbrouck Heights Hospital, Hasbrouck Heights, N. J.

Theodore S. Hodgins has resigned as VP—research of **Reichhold Chemicals, Inc.** and **Reichhold Chemicals (Canada), Ltd.** to open his own office as a chemical research consultant at 22 Greenley Rd., New Canaan, Conn. One of his principal clients will be RCI.

George R. Conover named to the newly created post of mgr. of plastic product sales for the **Bryant Div.** of **Westinghouse Electric Corp.** With the

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Announces

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The newly-dedicated $1,000,000 plus, 25,000 sq. foot Freedlander Research & Development Laboratory

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Modern industry's need for advanced materials is fulfilled by scientists at Freedlander Laboratory who are pioneering countless formulations and unlimited applications of new miracle STAFOAM.

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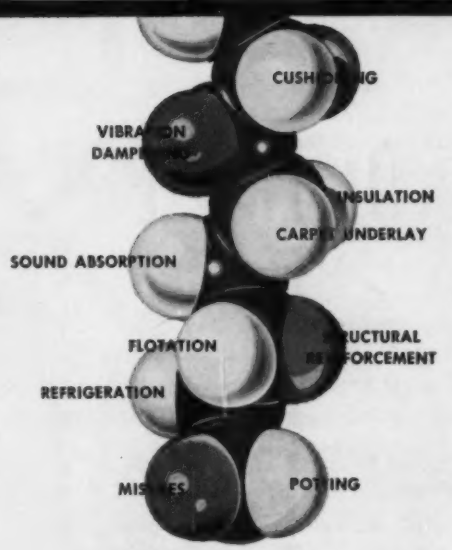
Revealing brochures and technical data on new miracle STAFOAM *will be mailed upon request.*



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The performance of Plastolein 9058 DOZ makes it the tailor-made plasticizer for quality vinyl fabrics. It imparts a soft, supple, warm feel and drape and, more important, it maintains these desireable appeals even under low temperature conditions and after prolonged aging in tropical climates. Thus, you can be sure that vinyls incorporating Plastolein 9058 will perform well and maintain their quality appeal at all times.

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Companies... People

company 12 years, he will now be responsible for the sale of plastic dinnerware as well as custom molded plastic products for equipment manufacturers.

William D. Hedges elected VP—research and development of **Columbus Coated Fabrics Corp.**, Columbus, Ohio. He will supervise all development work on new and existing products and will continue to direct the chemical laboratory.

William E. Browning named sales mgr. of **Panta-Pak Div., The Pantasote Co.**, New York and New Jersey. He was formerly sales mgr. of United Can Co. and Doeskin Products.

Panta-Pak Div. is engaged in the manufacture, distribution, and sales of Panta-Pak, a new vacuum formed plastic packaging medium. A license agreement for the manufacture of this material, which was developed in Italy, was signed recently by **Compagnia Italiana Nest-Pack S.P.A.**, Bologna, Italy, and Pantasote.

James H. McCormick, of **Du Pont**, was elected pres. of the American Association of Industrial Editors at that group's recent annual convention. As part of this function, his group will edit more than 20 publications in 1958. With Du Pont over 15 years, Mr. McCormick is in charge of the advertising, promotion, and merchandising of the company's new thermoplastic, Delrin acetal resin.

Murray Nadel elected treas. of **Augusta Plastics, Inc.** and **Sapery Products, Inc.**, 3820 Boston Post Rd., New York 69, N. Y. Augusta is a custom injection molder; Sapery produces a proprietary line of cosmetic packages.

George Rieger has joined **Amoco Chemicals Corp.**, Chicago, Ill., as dir. of research and development. He was formerly mgr. of market research of Diamond Alkali Co.

Gilbert E. Collyer appointed contract mgr. of **Aries Associates, Inc.**, Stamford, Conn. He will be responsible for consulting liaison between the chemical process and electronics industries and the Aries organization in the United States.

Albert P. Shutts, with the company 12 years, appointed sales mgr. of **Becco Chemical Div., Food Machinery & Chemical Corp.**, Buffalo, N. Y.

Frank L. Bracy, previously a development engineer in the Research and Development Dept., promoted

to tech. service engineer of **Plax Corp.**, Hartford, Conn. The firm produces plastic bottles, oriented plastic film and sheet, and polyethylene sheet material.

Frederic A. Bovais promoted from sales mgr. to VP and gen. mgr. of **Thomas Mfg. Corp.**, Newark, N. J., producer of plastic toys and novelties.

Andrew J. Paucek, appointed to the newly created post of mgr. of the plastics assembly and mica manufacturing plant of **Sylvania Electric Products, Inc.** at Titusville, Pa. He was formerly mfg. supt. of the plant.

Raymond J. Mucci now assistant to the gen. mgr. of **Naugatuck Chemical Div., United States Rubber Co.** He will be engaged in general forecasting and business research assignments.

Robert M. Ulmer appointed asst. gen. sales mgr. of **Armstrong Cork Co.'s Glass and Closure Div.**, Lancaster, Pa.

Harry M. Dent, Jr. named dist. sales mgr. for **Durez Plastics Div., Hooker Chemical Corp.**, N. Tonawanda, N. Y. Mr. Dent's sales district, centered at the division's home office, includes New York state (except New York City and the Hudson River area), western Pennsylvania, Ontario, and Quebec. He will be responsible for Durez salesmen in that district selling phenolic and polyester molding compounds, phenolic resins, and Hetron fire-resistant polyester resins.

Philip J. Rodgers appointed tech. rep. of **Claremont Pigment Dispersion Corp.**, Roslyn Heights, N. Y. He will service gravure and flexographic printers and vinyl compounders in the greater New York metropolitan area.

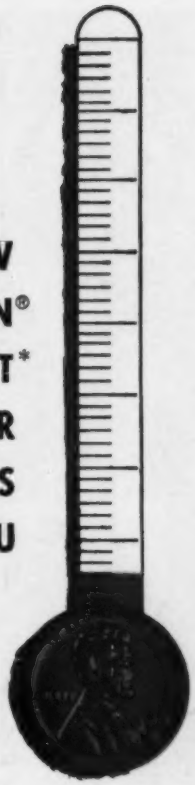
A. C. Groce named southeastern sales rep. of **Harwick Standard Chemical Co.**, with headquarters in Greenville, S. C. The company will also have warehouse facilities at this point.

Kevin E. Joyce named tech. sales rep., extrusion materials, for **Bakelite Co., Div. of Union Carbide Corp.** He will cover the Middle Atlantic area, operating out of Washington, D. C.

John W. Quinn, formerly with Remington-Rand, Boston, Mass., named to represent **Synthane Corp.**, Oaks, Pa., in various parts of New England and New York.

Correction

"Dustless PVC eases processing" (MODERN PLASTICS 35, 131, June 1958): Correct name of third author is John T. Barr.



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low-temperature flex and low cost!

Properties superior to adipates, yet in same price range

New Plastolein 9078 LT Plasticizer possesses an outstanding combination of properties that makes it very attractive as an economical low-temperature plasticizer. A unique product derived from Emery's Ozone Oxidation Process, Plastolein 9078 offers many advantages over the adipates, including better low-temperature flex, volatility, increased compatibility, lower mineral oil extraction, and higher efficiency.

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*Low temperature

Comparison of Plastolein 9078 with di-decyl adipate

Plastolein 9078		DDA	Plastolein 9078		DDA
Parts Geon 101	100	100			Borderline
Parts Plasticizer	48	49	Masland Impact, °C	—40	at —40
Tensile, psi	2650	2400	Extraction, mg/in²		
Elongation, %	365	360	Water, 24 hrs. @ 50° C	0.2	0.1
Modulus, 100%, psi	1130	1240	Soapy Water, 24 hrs. @ 50° C	1.0	0.4
Hardness, D.10 sec.	85	89	Min. Oil, 24 hrs. @ 25° C	11.1	19.8
Volatility, SPI, 70° C			Compatability, Roll		
1 day-mg/in²	1.9	2.3	Spew	Slight	Severe
7 days-mg/in²	8.0	9.1			

Organic Chemical Sales Department

Emery

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- ☐ Please send a pint evaluation sample
- ☐ Please send a technical representative

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An all-weather "Airhouse" of U. S. Rubber Fiberthin vinyl-coated nylon is manufactured by Irving Air Chute Co., Inc., Lexington, Ky. Thermatron generators and presses are used to weld the seams of the structure which is supported entirely by air pressure. At left an "Airhouse" is shown before inflating.

supported by air and THERMATRON electronic welding

No rigid wood or metal framework supports these unique houses — just a thin shell of vinyl-coated nylon and low pressure air. Part of the secret of Irving Air Chute's seemingly impossible "Airhouse" is the airtight, watertight seams permanently welded on Thermatron high frequency presses and generators.

Thermatron welding gives added strength to plastics—seams are actually stronger than the material itself! What's more, it's fast and economical, particularly important in such large scale applications as the "Airhouse," hatch and aircraft hanger protective covers and swimming pool liners.

High frequency plastic welding isn't limited to giant items—Thermatron is a vital cost-cutting, product-improving factor in the fabrication of toys, upholstery, clothing, luggage, automotive assemblies and many other plastic products. In fact, if you fabricate vinyl plastic in any way, Thermatron can point the way to faster and better production methods.

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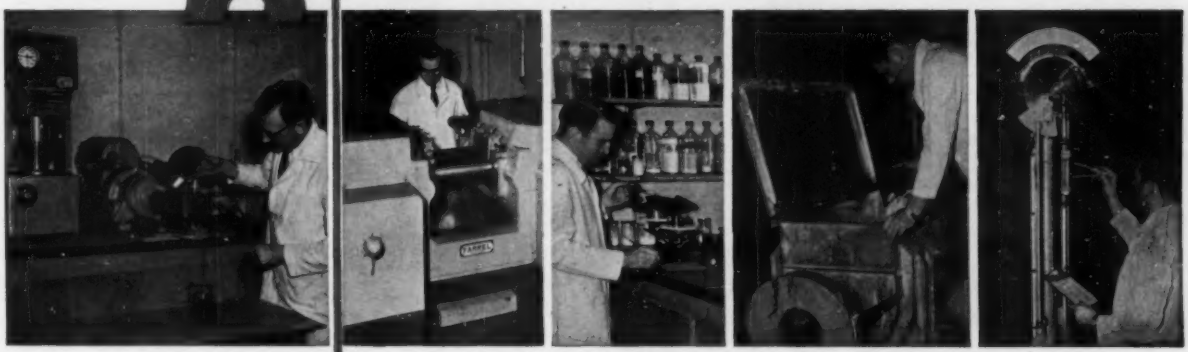

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Because they're saving money. Our processed vinyl and polyethylene DO cost less, but at the same time, precise laboratory control assures a product of the highest quality. Working with modern methods and machines, we are able to fill your raw material orders to EXACT specifications, at definite savings to you. HOW?

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Machinery and equipment for sale

EXTRUDER SCREW: 2½" N.R.M. 20-1 L/D general purpose vinyl. Never used, cost $650.00. Sale $500.00. Reply Box 3705, Modern Plastics.

FOR SALE: One 1951 model 16 oz. Watson-Stillman 385 ton plus injection machine. 47½ horse power. Fast cycle. Now running. First-class condition. Price, photographs, spare parts list available on request. Reply Box 3704, Modern Plastics.

EQUIPMENT FOR SALE: 3—Stokes 200 ton semi-automatic presses. RB-1 Stokes preform machine. RDS-3 Stokes preform machine. DDS Stokes preform machine. Ball & Jewell #42 rotary cutter. Abbe Pebble Mill. 1—5HP, 7HP and 10HP gas fired boilers. Full line staple & fancy button molds. Merit Plastics, 30 Lincoln Place, Lynbrook, New York. Phone: LYnbrook 9-8508.

FOR SALE: One Watson-Stillman 16 oz. press purchased new in 1954. In excellent condition. Press completely modernized just last year. In A-1 condition. Can be seen operating. Price and photographs upon request. Reply Box 3722, Modern Plastics.

FOR SALE: One Brown 48" continuous vacuum forming machine (plug assist) $6000. One 32 cavity cup die (inserts) plug assist and trim fixtures. $3000. One diamond punch press, model 3048-6-10-409 $4800. Injection Molding Company, 75th & Cleveland Streets, Kansas City 30, Missouri.

FOR SALE: 1 porter 35 cu. ft. stainless steel blender; 1 MPM 1½" electrically heated extruder; 1 22 x 60" plastics mill, 150 HP; 5 laboratory compression molding presses, 10 to 50 tons; 2 Ball & Jewell rotary cutters, #1 and #1½, MD; also presses, cutters, mixers, etc. Chemical & Process Machinery Corp., 52 Ninth St., Bklyn. 15, N.Y.

FOR SALE: Vacuum metallizers 36", 48". Injection presses: automatic stokes 4 oz. Watson 5 oz.—HPM 24 oz. to 4 oz. Reed 22 oz. to 4 oz. Lester 8 oz. Watson 48 & 28 oz. De Mattia vertical 4 oz. Lewis 6 oz. Moslo 2½ oz. Van Dorn 1 oz.: For extruders: 30" sheet die & 52" pull-off. 36" Brown vacform & plug—assist setup f. continuous extrus.—Cumberland No 0 & 10 grinders.—Apex 2 col. container imprint mach.—compression presses various sizes. Tavannes automatic cap mold presses.—Preform presses Stokes 280 G & Defiance 45. Baker—Perkins 200 gall. mixer. 43 cft Ribbonmixer.—VacForming machines 30 x 30", 42 x 60".—Dake 200 T. Hydr. Press.—All midwest locations. Wanted: Extruders 1½ to 6".—Justin Zenner, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: 1 Baker Perkins 15USE, 100 gal. all stainless double arm Vacuum mixer; 1—Baker Perkins size 15VUUM, 100 gal. double arm mixer, 100 HP motor; 1—Baker Perkins size JNM 100 gal. double arm mixer; 6—Day 250 and 100 gal. double arm mixers; 1—Ball & Jewell #1 Rotary Cutter; 2—Two Roll Mills 6" x 12"; 6—Stokes model DD2, DS3, D3 and B2 Rotary Preform presses; 4—Stokes model "R" single punch Preform presses; Also: Sifters, Banbury mixers, Powder mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

FOR SALE: 64 oz. Injection Molder with Pre-Plasticizer mold size 32"x50" 750 Ton clamp. Lester 8 oz. Model 2½ [illegible] (1949). DeMattia 12 oz. (1946). DeMattia 4 oz. H.P.M. Rubber Injection molders, 21½" x28" mold space, steam heated platens. Watson-Stillman 300 ton Semi-Automatic Compression molding press (1947) self-contained, mold size 34"x27". Watson-Stillman 250 ton 28"x24". Watson-Stillman 140 ton 22"x16". Waterbury Farrel 85 ton 20"x24". W.F. 63 ton 15"x15". Laboratory Presses—15 ton 10"x8" and 10 ton 6"x6" Platens. Scrap Cutters, Valves, Accumulators, Hydraulic Presses —all sizes. Aaron Machinery Co. Inc., 45 Crosby St., New York, N.Y. Tel.: WAlker 5-8300.

FOR SALE: 12—Baker-Perkins 200 gal. Sigma-blade mixers; 6—Pfaudler 500 gal. glass-lined reactors. Farrel-Birmingham 1500 HP horiz. reducer, 5:1 ratio. Ribbon mixers 336, 100, 75 cu. ft. Stokes tablet or preform presses, rotary cutters, mills, etc. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: (6) 100 ton, 10" ram, 10" stroke @ $1250; (7) 200 ton, 9" stroke, 14" ram, 36x36, @ $2160; (6) 200 ton, 9" stroke, 15" ram, 30x30 @ $1850; (1) ton complete, 18x18 @ $1850; (1) 200 ton 16" ram, 30x30 @ $2460; (2) 200 ton 16" ram, 42x42 @ $2850; (1) 200 ton, 15" ram, 42x42 @ $2600; (3) 250 ton (2) 12" ram, 30x60 rebuilt @ $3675. Hydraulic Sal-Press Co., Inc., 386-90 Warren Street, Bklyn, N.Y.

GOOD EQUIPMENT: At the right price. Falcon Ribbon Blenders in Steel or Stainless; NRM 2½" Extruder, Rotary Cutters by Ball & Jewell, Sprout-Waldron, Abbe; Baker Perkins heavy duty dbl. arm Mixers, 100, 200, 300 gal; French Oil Mill Hydr. Press 450 Ton; Blaw Knox S/S Resin Kettle 7'6"/7'6", Jktd. Agtd.; Sturtevant 300 cu. ft. Batch Mixer; Stokes and Colton Rotary and Single Pre-form Presses; Send for new First Facts, containing complete illustrated inventory; First Machinery Corp., 209 Tenth St., Bklyn 15, N.Y. Fred R. Firstenberg, Pres.

LIQUIDATION SALE: Molding Plant; (2)—325 Ton French Oil Compression Presses. (1)—300 Ton Erie Compression Press. (2)—170 Ton Transfer Presses. (1)—100 Ton Compression Press. (3)—75 Ton Transfer Presses. (1)—No. 5½ T Colton Preform Machine. (1)—3 DT Colton Preform Machine. Reply Box 3701, Modern Plastics.

FOR SALE: 1—100 ton hydraulic press with pump and motor 22" x 22" platens—$1,500.00. 4—100 ton hydraulic presses 18" x 18" platens with pump and motor—$1,200.00. 1—Banbury mixer—3A. 4½" NE extruder—$2,000.00. 10 H.P. pumping units with tanks unused—$450.00, and used pumping units without tanks—$200.00. Reduction units. Ludonite Corp., 88 St. Francis Street, Newark, N. J.

FOR SALE: Stokes DDS2. Unused. Stokes RD3 Stokes Rdi. Stokes T-50 ton Stokes standard press. Synthetic Plastics Co., 88 St. Francis Street, Newark 5, N. J.

FOR SALE: 100 gal. jacketed stainless mixer Baker Perkins. 3 ribbon mixers. 2 BB double arm mixer. 4—50 ton Watson Stillman presses self contained. Machincraft Corp., 800 Wilson Avenue, Newark, N. J.

FOR SALE: Stokes 300 ton and Baldwin-Southwark 200 ton semi-automatic Transfer Molding presses. 2500 ton downstroke 54"x102". 300 ton multi-opening 40"x40". French Oil 250 ton 38"x28". Elmes 200 ton 28"x26". Farrel 200 ton 20"x80". 200 ton Hobbing Press. 200 ton 16" Record Presses. D&B 140 ton 36"x36". French Oil 120 ton self-contained. W.S. 120 ton 24" x24". Also Lab. Presses to 100 tons. Hydraulic Pumps and Accumulators. Van Dorn 1 and 2 ounce Injection Machines. Other sizes to 80 oz. Baker-Perkins and Day jacketed Mixers. Plastic Cutters. Oxford 57" Slitter, Seco 6"x13" and 8"x 16" Mills and Calenders. Oil and Elect. Plastic Extruders, lab to 6". Single & Rotary preform Presses ½" to 4". Partial listing. We buy your surplus machinery. Stein Equipment Co., 107—8th Street, Brooklyn 15, New York.

JUST SECURED: Most Modern Packaging and processing machinery. Equipment installed within last 2 years. Available at great savings. 4—Hayssen model F compaks with net weight scales, bulk and dribble feeds, electric eyes. 4—Ceco model 40-9½-GG automatic adjustable cartoning units. Also model TT. 1—Pneumatic Scale automatic carton feeder, bottom sealer and top sealer with interconnecting conveyors. 6—Fitzpatrick model D-6 Stainless steel comminuters 4—Day size G. 1500 lb. Ribbon type powder mixers. 2—Rietz distintegrators model RD18 complete with 50 HP motors. 1—Enterprise Foundry Disintegrators model EVM3 complete with 50 HP motors. Complete details and quotations promptly submitted. Union Standard Equipment Company, 318-322 Lafayette St., New York 12, N. Y., Phone: CAnal 6-5334.

FOR SALE: Practically new—3¼" Hartig extruder, complete with extra long barrel, 25 H.P. U.S. Varidrive, cored screw for cooling, cast heaters, prewired panel, with complete take-off equipment for blown film extrusion—6" blown tubing die, air rings, hoses and blower. Many other extras — including stainless steel trough, variety of pipe and tubing dies, cross head attachment. Most never used and still in original packing cases. Reply Box 3708, Modern Plastics.

Machinery wanted

WANTED: Laminating or combination laminator-embossing machine capable of handling 60 to 70 inch widths of lightweight flexible plastic films. Must be in good condition, no more than 7 to 10 years old. Reply Box 3714, Modern Plastics.

WANTED TO BUY: Used injection molding machines, ovens, granulators. One machine or complete plant. Acme Machinery & Mfg. Co. Inc., 20 South Broadway, Yonkers, N. Y. YO 5-0900, 102 Grove Street, Worcester, Mass., Pl 7-7747.

Materials for sale

FOR SALE: Styrene, hi-impact, regular. Large quantities reground available, pastel shades, also white. Low prices. Write, wire or phone, Success Plastics Corporation, P. O. Box 506, Indianapolis, Ind. Liberty 6-2919.

(*Continued on page 220*)

IMS PURE
SILICONE FLUID
MOLD RELEASE SPRAY

EXCLUSIVE, FAST,
ALL-METAL VALVE
ENDS FUMBLING
SAVES CYCLE TIME
Keeps Mold Lube
Cost Down

It Isn't Size —
It's Performance
and Quality
That Count!

PRICES (Delivered)
Sample Can.....$2.00
Per Unbroken Dozen.....$18.00
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The Economical Way to Buy and Apply Pure, Costly Silicone Fluid!

To Cover All Molding Conditions Keep Both Types on Hand

IMS PURE
ZINC STEARATE
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HANDY MOLD DUSTER
Quick—Convenient
Removable, Cleanable Spray Head Directs Dust Into Cavity Without Waste.

PRICES (FOB Cleveland)
Sample Can.....$2.00
Per Unbroken Dozen.....$13.80
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IMS Mold Releases are designed to bring you maximum quality and performance. Our Silicone Fluid Spray utilizes only more costly volatile Freon to minimize part marking on fast cycles. The Dry Powder Spray should be used in all applications where painting or plating follows the molding operation, also in preforming.

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(*Continued from page 218*)

FOR SALE: 30,000 lbs. polyethylene pellets, nat. & std. Toy colors. 40,000 lbs. virg. hi impact std. baby pink, baby blue, med. blue, green, white, black, & mix colors. 4000 lbs. reg. zytel 101, nat. or white. Repr. red acetate MH. 10,000 lbs. reg. flesh plastisol, hard & soft. 9000 lbs. reg. flesh acetate, 20,000 lbs. black G. P. Styrene pellets. Low prices. Reply Box 3715, Modern Plastics.

FOR SALE: Virgin high impact and medium-impact polystyrene. Natural, white, pastels, toy colors, and dark colors; also, virgin Polyethylene, natural and all colors. Prices—5¢ to 10¢ below regular list. Samples on request. Reply Box 3720 Modern Plastics.

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WANTED—POLYETHYLENE: Film-Sweepings-Purgings-Parts. Also: Other Types of Plastic Scrap. Claude P. Bamberger, Inc. One Mount Vernon Street Ridgefield Park, N.J. Telephone: HUbbard 9-5330.

MIDWEST MANUFACTURERS: Machinery lines wanted for plastics and packaging Industry—East coast Philadelphia to Boston—commission basis—Technical Product Co., 369 Lexington Ave., N.Y.C. MUrray Hill 3-6137.

NYLON SCRAP WANTED: By reprocessor. All kinds including molding, extrusion and fabricating. Quotations promptly furnished on all grades and polymer types. Adell Plastics, Inc., 5208 Elinor Avenue, Baltimore 15, Md.

WANTED: Plastic of all kinds—virgin, reground, lumps sheet and reject parts. Highest prices paid for styrene, polyethylene, acetate, nylon, vinyl, etc. We can also supply virgin & reground materials at tremendous savings. Address your inquiries to: Gold-Mark Plastic Compounds, Inc., 4-05 26th Ave., Long Island City 2, N. Y., RAvenswood 1-0880.

PLASTIC SCRAP WANTED: From molders, vacuum formers, fabricators; acrylic, styrene, polyethylene, acetate, butyrate, etc. For top prices write, wire, phone collect Philip Shuman & Sons, 15-33 Goethe St., Buffalo 6, N.Y. Tel: HUmboldt 1811.

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Molds wanted

INJECTION MOLDS: for 2 oz. Van Dorn machine novelties, stirrers, combs, cups, spoons, forks, paper cutters, balls, Artifacts, Buttons. P.O. Box 93, Christiansted, V. I.

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WANTED: An experienced salesman in plastic display fixtures, who can handle office inquiries, credits and general details. Located in New England area. Information held confidential. Giving full resume, references, experience, education and salary required. Reply Box 3707, Modern Plastics.

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AGENTS: Sales agents to represent established custom extrusion company. Protected territories; some in midwest now open, some with established accounts. Aggressive and creative approach to sales and service. If you have proven ability in plastics sales, write now for complete proposal, giving resume and other lines carried. Quick Plastics Division, 1680 Cooper St., Jackson, Michigan.

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CANADA—FOR RENT: Small molding shop with one R.P. 8 oz. machine. Scrap grinder, drying ovens, conveyor assembly, air operated presses, tool shop, etc. Contact J. Tully, Jr. J. A. Willoughby & Sons Limited Realtors, 46 Eglinton Ave. E., Toronto, Ont.

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CAPITAL TO INVEST: Commercial and real estate financing. 1st & 2nd Mortgages. Construction loans. Chattel loans on machinery, equipment, fixtures & inventory. Sales & leaseback. Present financing consolidated and increased. Payments reduced. Receivable discounting. Re-discounting and installment financing. Long term subordinated note and debenture financing. New ventures financed. Promotional financing. Sy Field Co., 1457 Broadway, N. Y. WI 7-7395.

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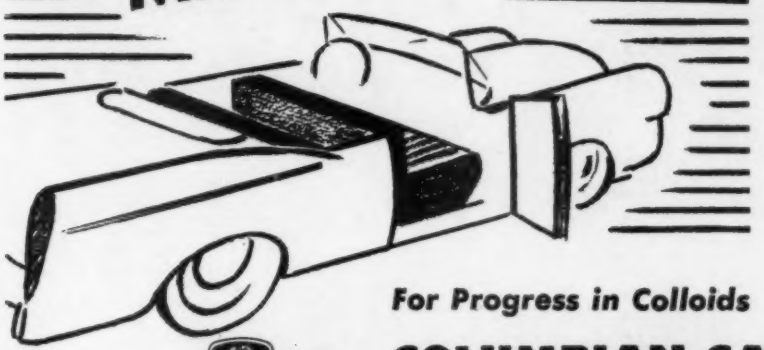

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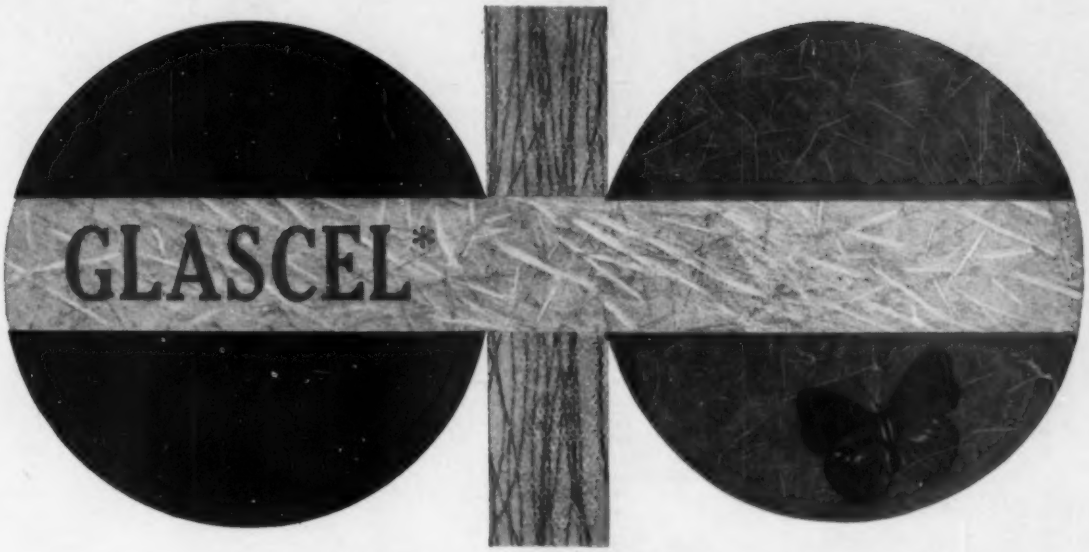

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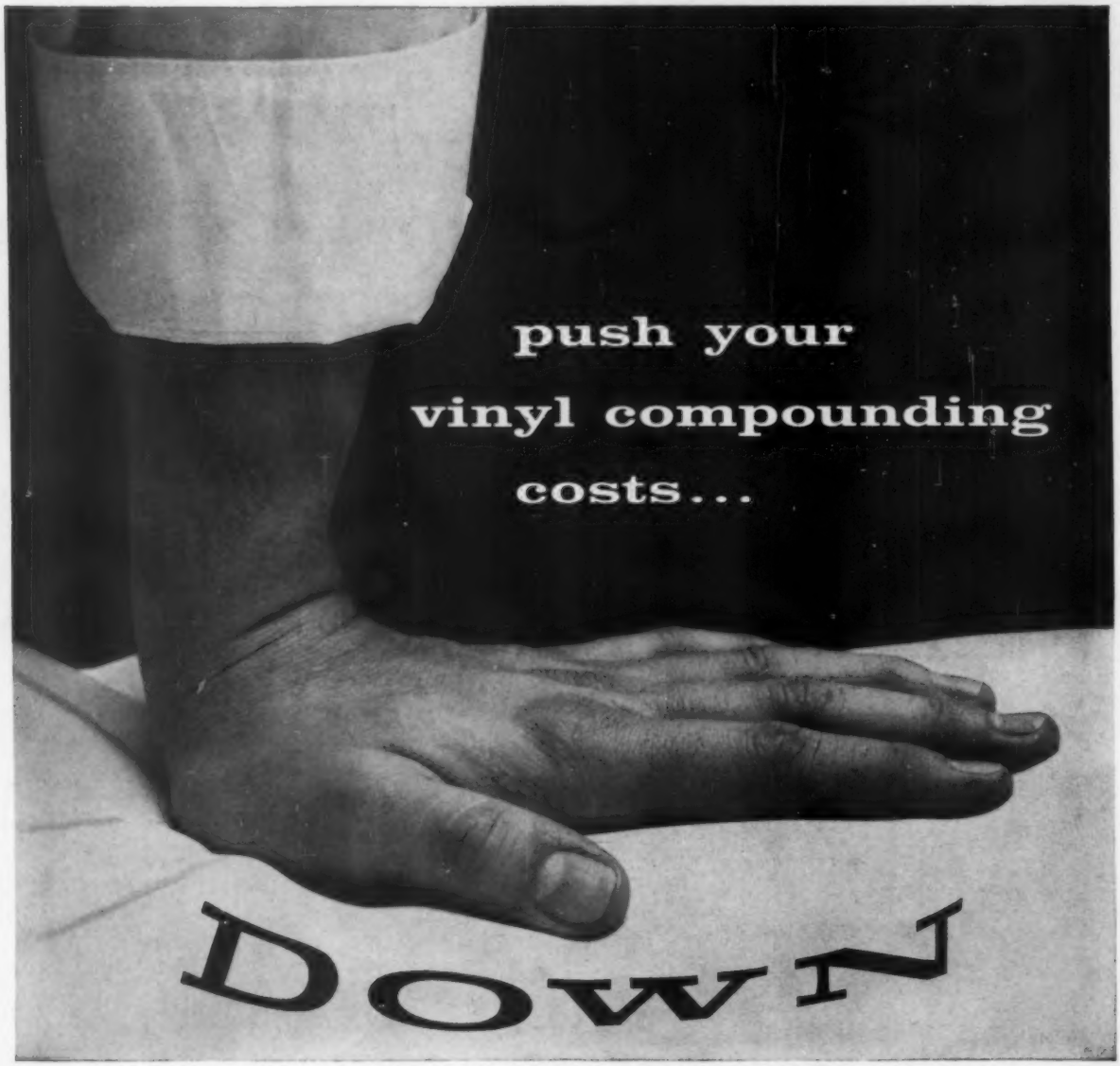

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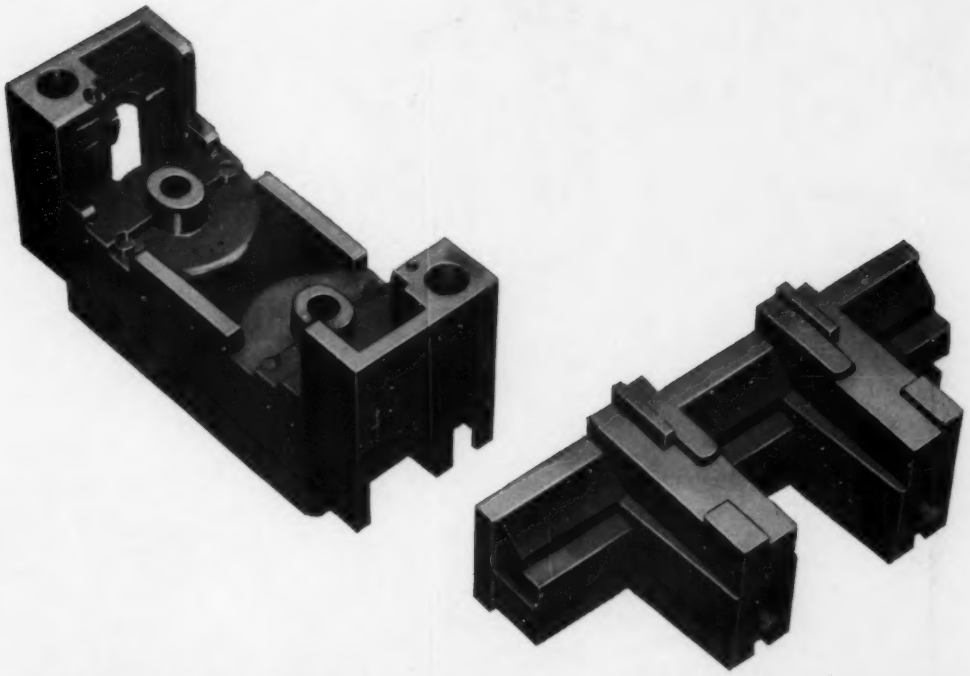

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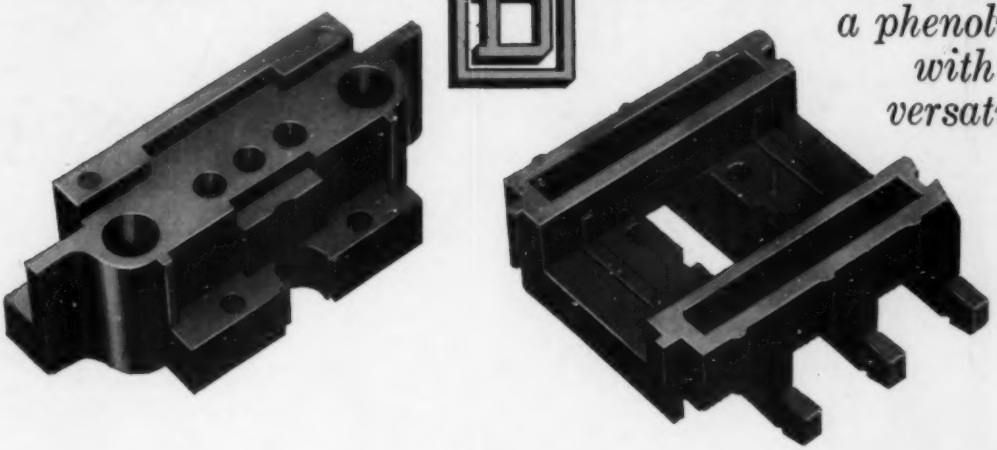

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Square D Company needed a phenolic that could be molded on automatic presses to produce electrical parts of many different sizes, shapes, and uses. Their specifications also required good dimensional stability, rigidity, high heat resistance, low water absorption, outstanding electrical properties.

Square D chose G-E 12929 because it fits *all* of these requirements—and has good moldability as well.

G-E 12929 is easy to set up on any compression or plunger molding equipment. Cure cycle is short. The compound can tolerate a wide temperature range during molding. It is not critical with respect to other molding variables. One flow covers many different parts, including those with thick and thin sections. High barriers fill out well.

Here is another example of the extra values molders realize from phenolics — lowest in price of thermosetting materials, highest in performance where the specifications call for exceptional heat resistance, dimensional stability and rigidity.

For more complete information about G-E 12929 and other G-E compounds, write General Electric Company, Chemical Materials Dept., Section MP 68, Pittsfield, Mass.

Phenolics-first of the modern plastics...first in value

GENERAL ELECTRIC